

SERVICE MANUAL

2100 & 2300 SERIES

H000-001275

CAUTION

SEE SAFETY NOTICE ON
INSIDE COVER SHEET



HAMMOND ORGAN COMPANY

A DIVISION OF MARMON COMPANY

A MEMBER OF THE MARMON GROUP OF COMPANIES

4200 W. Diversey Avenue

Chicago, Illinois 60639

[312] 283-2000



2182

CABINET SIZE - APPROX. 53-1/2" W
43" DEEP, 51" H (MUSIC RACK UP
AND PEDALS)

WEIGHT W/BENCH - APPROX. 395 LBS

POWER OUTPUT - 2 POWER AMPLIFIERS
RATED AT 35 WATTS RMS EACH.



2195

983-3025

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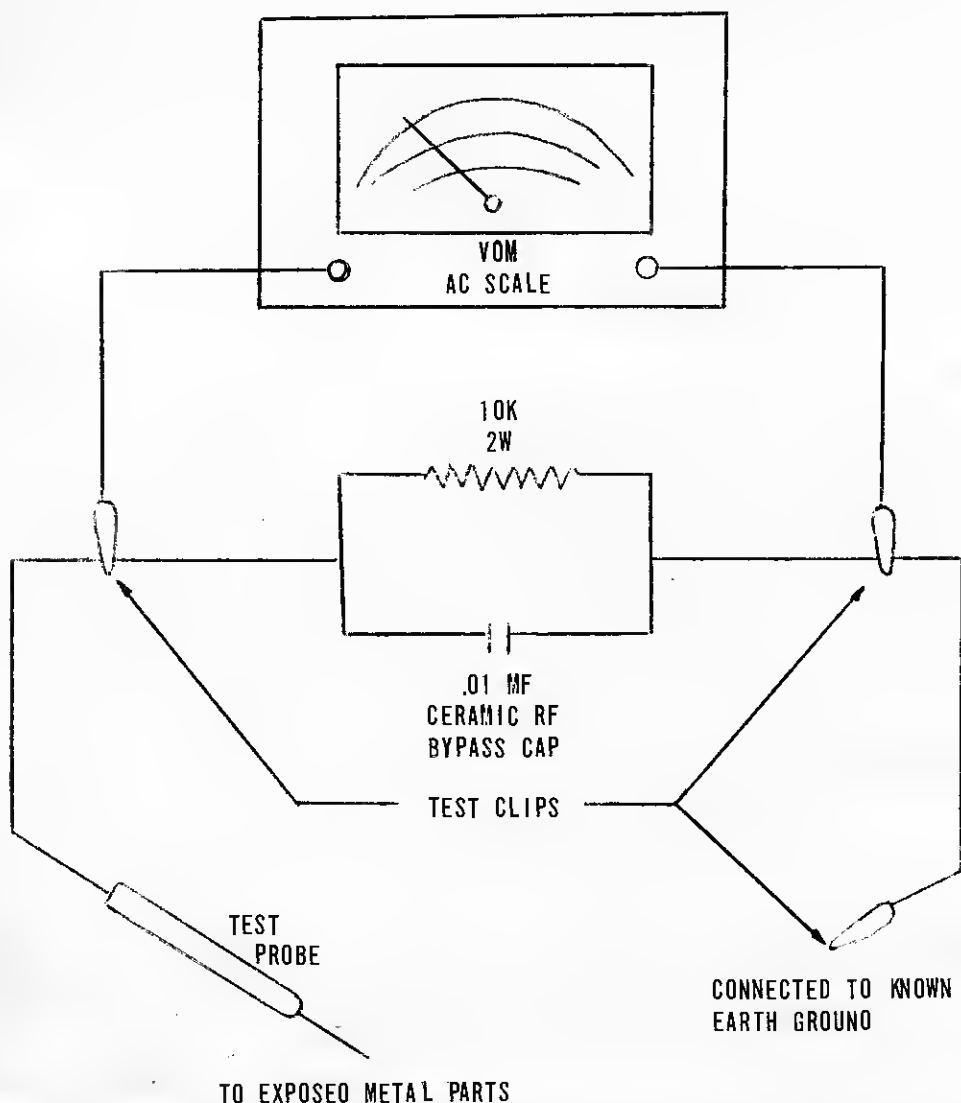
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SAFETY NOTICE

Great care has been taken in the design and manufacture of this product to assure that no shock hazard exists on any exposed metal parts. Internal service operations can expose the technician to hazardous line voltages and accidentally cause these voltages to appear on exposed metal parts during repair or reassembly of product components. To prevent this, work on these products should only be performed by those who are thoroughly familiar with the precautions necessary when working on this type of equipment.

To protect the user, It is required that all enclosure parts and safety interlocks be restored to their original condition and the following tests be performed before returning the product to the owner after any service operation.

Plug the AC line cord directly into a line voltage AC receptacle (do not use an isolation transformer for this test) and turn the product on. Connect the network (as shown below) in series with all exposed metal parts and a known earth ground such as a water pipe or conduit. Use an AC VOM of 5,000 ohms per volt or higher sensitivity to measure the voltage drop across the network. Move the network connection to each exposed metal part (metal chassis, screw heads, knobs and control shafts, escutcheon, etc.) and measure the voltage drop across the network. Reverse the line plug and repeat the measurements. Any reading of 4 volts RMS or more is excessive and indicates a potential shock hazard which must be corrected before returning the product to the user.



SECTION I

HOW THE ORGAN OPERATES

CONCORDE - 2100 SERIES

- 1-1 GENERAL PERFORMANCE DESCRIPTION.
--This section briefly describes the features of the instrument. It includes an account of the various functions and controls, as well as the effects they produce.

The Concorde is a self-contained console with two 61-key manuals and a 25-note pedal keyboard. It uses a synthesis type tone generating system. Additional features include preset keys, tone bars, automatic rhythm with Auto-Accompaniment and arpeggiator.

- 1-2 MANUALS.--There are two 61-key manuals of current block module design. Each key has a single contact to a non-grounding bus, providing a means for switching the keying voltage to the divider-keyers. Both manuals pivot upward for easy access.
- 1-3 TONE SOURCE.--The Concorde uses a crystal controlled, multi-derivative divider system (MDD) of exceptional accuracy and stability. The output of a single master oscillator is divided into 13 top frequencies by the large scale integrated circuit network (LSIC) on the MDD board, which, in turn, drives four generator-keyer systems. These Mother boards provide the necessary division of outputs and frequencies which are subsequently shaped and synthesized into tones keyed by the manuals.
- 1-4 POLYSYNTHESIS/PERCUSSION.--Two of the main generator-keyer systems are used for percussive voices.

- Bright tones which are filtered to form the Pizzicato, Banjo, Harpsichord and Piano voices.
- Individual pure harmonics (1 through 8) and three synthesized combinations of these harmonics (Glock, Xylophone, and Marimba).

All percussive voices are heard only when the upper "B" adjust key is down, except for "Piano Solo". In order to hear any percussion registration without tone bars, the tone bars in the "B" group should be pushed in. If any of these tone bars are extended, the harmonic sound actuated will be louder than called for in the preset being used. All percussive voices rise and decay independently with each key played (unlike most other Hammonds).

All percussive tones are heard only through stationary speakers, offering a contrast between non-vibrato percussion and regular organ tones channelled through the tremolo animation.

- 1-5 TONE BARS.--Four groups of tone bars are provided for the manuals and one group controls the pedals. They carry footage markings and control volume as on previous Hammonds, but are DC keyed instead of AC.
- 1-6 PRESET KEYS.--A special set of labeled keys located at the left of the manuals can be used to produce pre-set tones in lieu of adjusting the tone bars. They may be detented individually or in groups; giving more complex tones. Each key activates an arrangement of tones determined by one of 18 different plug-in printed wiring boards. Universal preset boards may be obtained, on which a serviceman can install special "made to order" voices. These custom boards may be interchanged with standard presets as desired. Such changes, of course, will conflict with names stamped on preset keys.

1-7 CONTROL TABS.--A line array of tabs along the entire length of a panel above the tone bars is provided for switching in special effects and additional voices.

1-8 TAB VOICES.--Blue tabs #1 through #6 and #8 select the same tones as the seven tone bars (in fully extended position) located directly below, but with an added sustain-percussion envelope. Xylophone and Marimba voices are a combination of #2 and #5 blue tabs with different degrees of extra decay. Glock is a combination of #2 and #5 blue tabs with 16' manual tone bar sound. Pizzicato #1 and #2 add very short decay to voices. Bright complex tones are derived and filtered to form the voices labeled Banjo, Harpsichord, and Piano. Piano Solo has the same tone as Piano but cuts out all other registration and has volume increased to FF level.

1-9 REPEAT TAB.--Applies reiteration to all percussive voices except Piano Solo. The rate knob selects the desired speed of reiteration. When used with Xylophone or Marimba tabs depressed, two harmonics are gated alternately, creating a twin-mallet effect.

1-10 PERCUSSION.--To increase the volume of all percussive voices, the Percussion FF tab is activated, except for Piano Solo which overrides it, and is always heard at the louder level. The Percussion Fast tab gives four degrees of decay (long, medium, short, and very short) as follows:

Blue Tabs		
#1 thru #6 and #7	From Medium	To Very Short
Glock		
Xylophone	From Short	To Very Short
Marimba		
Banjo		
Harpsichord		
Piano	From Long	Remains Long
Piano Solo		
Pizzicato		
#1 and #2	From Very Short	Remains Very Short

1-11 TREMOLO.--Tremolo upper and lower tabs are channel signals keyed by upper and lower manuals respectively, to rotary speaker. Rhythm, pedals, and percussion are not affected. Depressing Tremolo Celeste tab changes the rotary speed from fast to slow. The Tremolo Chorus tab action creates a 50/50 mixture between stationary and rotary speakers of all tones directed to Tremolo channel.

1-12 VIBRATO 1, 2.--By using these tabs a slow narrow or fast wide vibrato can be channelled to the stationary speakers.

1-13 REVERB 1, 2.--Used singly or together, these tabs provide three degrees of reverberation via the stationary speakers.

1-14 BRILLIANCE.--This tab adds a forward brightness to the manual tones and has no effect on pedals, rhythm, or percussion.

1-15 ECHO ONLY, MAIN AND ECHO.--For use with external tone cabinet, selects tone cabinet alone or in addition to console speakers.

1-16 SUSTAIN TABS.--The two upper sustain tabs (long, short) add two degrees of sustain to any tone bar registration on the upper manual, but not to the printed wiring board presets. Tab-Sustain Lower gives medium sustain to lower manual tone bar settings but not to other presets. Sustain to foot switch transfers long sustain on upper manual tone bars to foot switch on left side of expression pedal.

1-17 LOWER TO PEDALS.--Permits the 25 pedals to energize the first 25 keys on the lower manual.

1-18 EXPRESSION PEDAL.--An assembly of block module design, for controlling the audio output of three channels simultaneously. (Main, Tremolo, and Rhythm).

1-19 SIDE SWITCHES.--Located on the left and right side of the expression pedal. The left foot switch cancels signals to the Tremolo system and redirects them to stationary speakers. This switch also adds medium sustain to upper tone bar registration as mentioned in 1-16. The right foot switch cancels automatic rhythm.

1-20 SPEAKERS.--The main speaker compliment consists of a 15" bass and a 6" treble speaker. The Tremolo unit contains a 6 X 9 extended range speaker.

1-21 RHYTHM III ASSEMBLY.--An automatic rhythm unit with eight voices and fifteen rhythm patterns is located above the control panel. Two or more patterns may be played simultaneously if desired. Additional features are: Silent/Sound, Continuous/Touch Start, Tempo Control with indicator lamp, Foot Switch Reset, Volume Control, and follow-the-player voices.

The Silent/Sound tab is used to silence the audio for the automatic rhythm voices in the "Silent" position, and resets the timing generator when moved to "Sound". (Auto Accompaniment is not affected). By placing the Continuous/Touch Start tab in Touch/Start mode, with Silent/Sound tab in "Sound" position, rhythm patterns can be started or stopped by depressing or releasing a pedal or lower manual key. The Tempo knob controls the rate of rhythm beats. (48 to 300 per minute). The Tempo lamp

indicates four beats per measure when the unit is silent and flashes for each measure when the unit is "on". The Foot Switch Reset, in the "on" position and operating, causes the Tempo lamp to flash for every beat. The Volume knob, a dual-ganged control, varies the output of high and low frequency channels at the same time. Four toggle switches activate follow-the-player voices that respond to the Volume control and can be cancelled by the switch on the right side of the Expression Pedal. Bass Drum and Cymbal voices are keyed by the Pedals and the Lower Manual keys control Snare Drum and Brush voices.

1-22 AUTO-ACCOMPANIMENT.--Working in conjunction with the rhythm unit, but with its own electronics, is the Auto-Accompaniment provision. Bass notes and chords are gated by the rhythm unit to the main audio channel, in automatic patterns and tempo, along with regular rhythm voices. Auto-Accompaniment may be heard separately by turning down the volume control on the rhythm unit. Although pedals are disconnected when the Auto-Accompaniment is on, both pedal tone bars must be extended for proper sounding of high and low bass notes.

1-23 ARPEGGIATOR.--This 49-note device, of block module design, is mounted on the right side of the instrument, between the upper and lower manuals. A 2-way switch at the right of a mylar strip, selects manual or automatic operation. When set in manual mode, running a finger along the strip sounds a scale composed of notes keyed on the lower manual, in the voices selected on the upper manual. In automatic mode, pressure on the arpeggiator strip produces a pleasing arpeggio in the proper whole tone scale to harmonize with the keys depressed on the lower manual. When no keys are depressed, stroking the arpeggiator produces every note on a chromatic scale, (Glissando) in manual or automatic mode. Although lower manual keys and voices remain operable, the Arpeggiator can key upper manual voices only.

1-24 MUSIC LIGHT -- A switch on the right side of the Rhythm III unit, independent of the regular power switch.

1-25 CASSETTE -- A monaural cassette deck, with record-playback capability, is installed in the lower right hand end block. It has electronic speed regulation and automatic level control, and comes with a dynamic microphone. The organ output can be recorded directly, except for Reverb and Tremolo which must be added on playback.

These effects can be put on tape, however, if they are recorded through the microphone, placed at least three feet from the speakers.

1-26 PHONE JACK -- The phone jack is stereomono compatible, no adapter needed, and is located on the right side of the instrument, under the lower manual.

1-27 PHONO INPUT -- On the power amplifier chassis, an RCA-type jack is provided for use with external signal generating devices. Input impedance is 50K ohms and maximum signal permissible is 0.25V RMS.

1-28 POWER OUTPUT -- Two power amplifiers are used, of block module design, rated at 35 watts RMS each.

- - NOTES - -

SECTION II

DISASSEMBLY AND MAINTENANCE

DISASSEMBLY

- 2-1 PRELIMINARY NOTE.--These instructions describe a main disassembly sequence and procedures for removing and replacing specific assemblies. Re-assembly is accomplished by using reverse procedure. Ordinary hand tools of good quality will be adequate for these tasks. The most important rule of thumb to be observed is: **HANDLE ALL ASSEMBLIES WITH EXTREME CARE.** Stubborn fasteners must not be forced, but gently worked free. Fumbling and searching for parts can be minimized by setting aside an area where they can be kept until needed. Before starting, disconnect organ by unplugging A.C. power cord.
- 2-2 REAR COVER.--
- A. Remove three (3) hex head screws from top of rear cover.
 - B. Lift cover until free of groove in bottom of cabinet frame, then away from cabinet.
- 2-3 END PANEL ASSEMBLY, RIGHT HAND SIDE.--
- A. Remove four (4) hex head screws attaching end panel to cabinet frame. Two of the screws are at top and bottom of left rear corner of frame, (from rear) remaining screws are under manual shelf at extreme right (from front).
 - B. Swing hinged panel toward rear of cabinet.
- NOTE: On earlier models, end panel has no hinges and must be completely removed. Tilt away from cabinet and lift out of recess in frame.
- 2-4 TOP COVER AND PANEL.--
- A. From front of console, grip top firmly, and pry it loose from spring catches on each side, with steady pressure. Swing up top and hold in position.
 - B. On underside of panel, locate locking rod stored in right bracket. Insert rod through hole in frame at right rear corner, locking top in position. Repeat on left side, (from front).
- 2-5 LINE SWITCH.--
- A. Reach behind control panel, right side. Grasp all four retaining appendages of plastic switch module between thumb and forefinger, squeezing them firmly together.
 - B. Push switch out through front of panel. It may be necessary to wiggle assembly from top to bottom of slot a few times.
- 2-6 CONTROL PANEL.--
- A. From open side of cabinet, carefully pry control panel from base assembly, freeing spring catch.
 - B. Swing up control panel assembly.
- 2-7 RHYTHM UNIT ASSEMBLY.--
- A. From front - remove volume and tempo control knobs. At rear of unit, remove connector.
 - B. Remove three (3) hex head screws, (each side) attaching rhythm unit underneath top panel.
 - C. While lowering unit with one hand, free tempo lamp from plastic holder in panel.
- 2-8 MANUALS.--
- A. From under manual shelf, directly beneath lower manual end blocks, remove two (2) 1½" hex head bolts. (each side)
 - B. Raise upper manual first, then lower.

- 2-9 TONE BAR SWITCH.--
 A. Remove three (3) hex head screw mounting switch to sub-base.
 B. Disconnect and remove switch. Pedal tone bar switch has only two (2) fasteners.
- 2-10 NOTE: MANUAL KEYS.--Follow procedure as outlined in 2-25 "Manual Key Replacement".
- 2-11 MANUAL PRINTED WIRING BOARDS.--
 A. With defective manual in raise position, unplug connector at rear of printed wiring board.
 B. Remove five (5) hex head screws holding printed wiring board to manual frame.
 C. Slide printed wiring board toward rear of manual frame and gently disengage key actuators from contacts.
 NOTE: Contacts and actuators must not be bent or damaged.
- 2-12 ARPEGGIATOR AND FRONT STRIP.--
 A. Remove seven (7) hex head screws attaching front strip to bottom of upper manual frame.
 B. Using finger pressure only, pull cover off Auto-Manual switch. Remove front strip with arpeggiator.
 C. With pick or other pointed tool, pry loose five (5) spring clips holding assembly to front strip. Remove arpeggiator.
- 2-13 MANUAL FRAME ASSEMBLY.--
 A. On upper manual only, from front, right hand side, remove screw fastening chain to top panel.
 B. Remove two (2) hex head screws attaching manual frame hinge to mounting bracket on shelf, (each side).
 NOTE: Do not allow sharp edges of frame to mar left end panel.
- 2-14 PHONE JACK.--
 A. Place manuals in raised position. Located exterior of jack under front of manual shelf, at right. Remove retainining nut.
 B. Lift out assembly from top of shelf.
- 2-15 CASSETTE DECK.--
 A. Remove three (3) hex head screws from under manual shelf, right side, attaching assembly to shelf.
 B. Lift out deck with bracket.
- 2-16 EXPRESSION PEDAL.--
 A. From front, in well at bottom of cabinet, remove four (4) hex head screws mounting pedal to bottom shelf.
 B. Slide assembly slightly toward rear of shelf and lift out.
- 2-17 PEDAL KEYBOARD.--
 A. From front, pry up each end of crossbar where assembly joins cabinet.
 B. When studs clear retaining rail, lift front of keyboard until actuators are free of contacts.
 C. Move assembly away from instrument.
- 2-18 TREMOLO.--
 A. From rear of cabinet, remove cable connectors.
 B. Remove one (1) retaining screw securing Tremolo housing in cabinet groove, (each side).
 C. Slide out housing assembly.
- 2-19 AMPLIFIER AND POWER SUPPLY.--
 A. From rear, remove one (1) pal nut from each corner of chassis.
 B. Remove cable connectors, lift out.
- 2-20 REVERB.--
 A. From rear, remove two (2) pal nuts from reverb chassis, (each side)
 B. Unplug connectors, remove assembly.
- 2-21 SPEAKERS.--
 A. Both main speakers are fastened to grille panel from rear, with four (4) pal nuts.
 B. When connecting speakers, green wire must be secured

to terminal next to red dot to insure proper phasing.

2-22 CRILLE PANEL --

- A. Remove end panel assembly, left hand side, using procedure given in Section 2-3.
- B. Carefully remove snap-on molding beneath manual shield.
- C. Remove two (2) pal nuts attaching grille panel to cabinet frame, (each side).
- D. Crille cloth replacement entails pulling out staples and old cloth and restapling new cloth in place.

2-23 SWING OUT PANEL --

- A. From top rear, at center of console, rotate latch parallel to panel.
- B. Hinges at bottom of panel permit it to be lowered.

2-24 REMOVAL OF PRINTED WIRING BOARDS - -

- A. Disconnect all plugs connected to printed wiring boards before removal. ALWAYS CROUND YOURSELF to the organ chassis before touching a board containing a 380 or 426 I.C.
- B. Rhythm, Reverb Amp, Power Amp arpeggiator, and keyboard printed wiring boards are attached to their respective assemblies. Percussion and manual synthesis daughter boards are retained in fibreboard arrays over associated mother boards. Other printed wiring boards are secured by special plastic retainers. In most cases, a printed wiring board can be detached from retainers with a parallel, sliding motion. If necessary, one retainer can be bent away from board and it can be lifted free.
- D. Use chart below to locate printed wiring boards.

NOTE: Any bending or twisting force applied to boards, can damage copper foil.

FROM FRONT OF CABINET

Upper Manual Presets
After Vibrato - Main
Bright Wave Percussion #1
Bright Wave Percussion #2
Mixer #3
Pedal Filters

Top Panel - Left
Top Panel - Right
Manual Shelf - Center Right
Manual Shelf - Center Left
Manual Shelf - Right
Manual Shelf - Left

FROM REAR OF CABINET

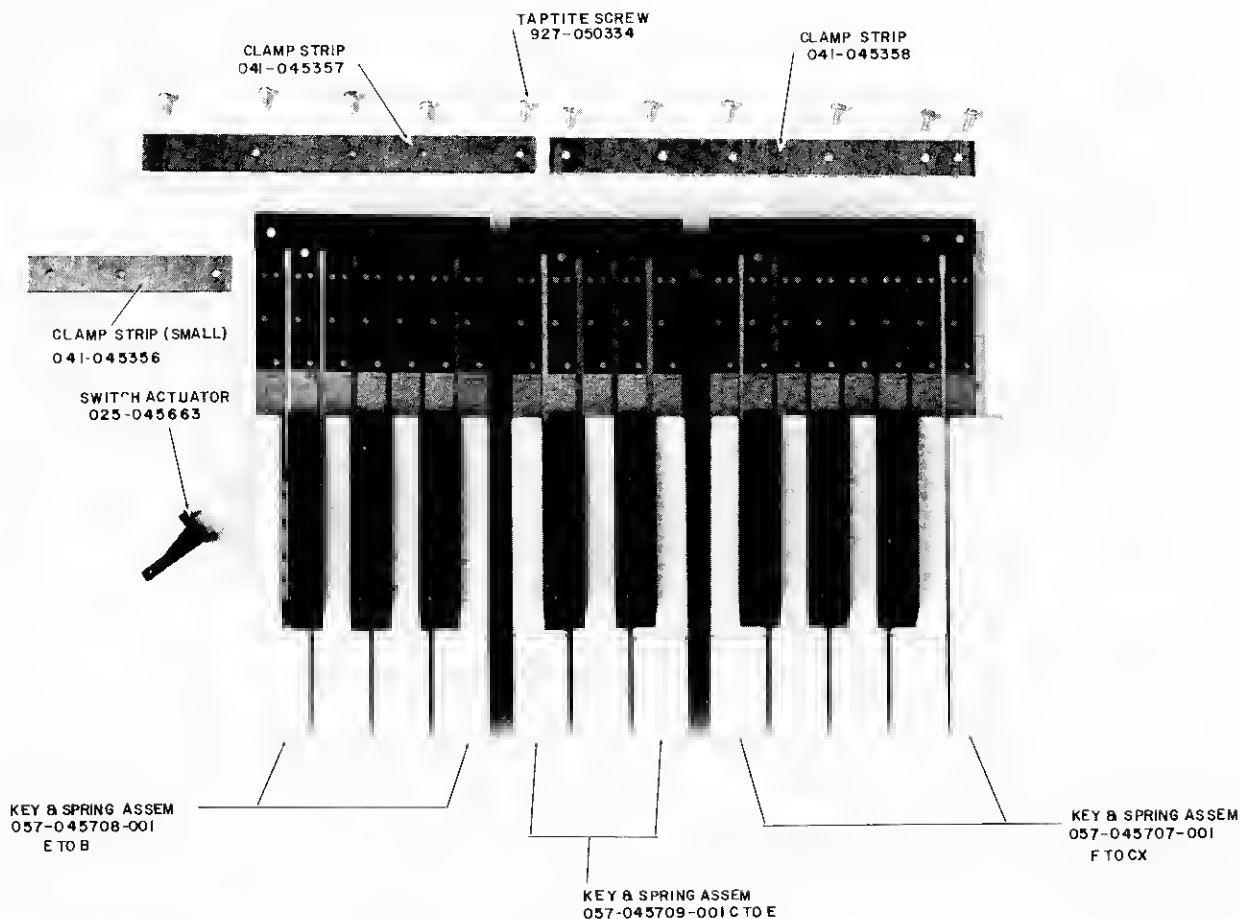
Sine Filters #1,2,3, for upper and lower manuals.
Lower Manual, Synth., Mother & Daughter Boards
Upper Manual Synth, Mother & Daughter Boards
Bright Perc. Mixer #1 (EARly Models) or Autochord
Mixer #2, Synth. Perc. Cates
After Vibrato - Tremolo
Piano Filters
Sine Filters #1, 2, 3, for Synth. Perc.
Poly-Synth. Perc. Mother & Daughter Boards

Outer Swing out Panel
Inner Swing Out Panel - Left
Inner Swing Out Panel - Right
End Panel - Right
Underside of Manual Shelf - Right
Center Partition - Right Side
Bottom Shelf - Right

2-25 TO REPLACE UPPER OR LOWER MANUAL KEY

Keys cannot be replaced individually. Key module or key section will be needed. See "Key and Spring Assemblies" illustration to determine which module or section is to be used.

- A. Proceed by removing screws and strip associated with defective module.
- B. Lift rear of key module and carefully push forward separating actuator from contacts and lift up. Care must be taken when removing actuator from contacts as not to bend or damage contacts.
- B. Reassembly in reverse procedure.



MODEL 2100 PRODUCTION CHANGES FOR

SERIAL NO. 376837 AND ABOVE

The following changes were incorporated into production starting with the SERIAL NUMBER 376837. All Models of the Concorde are included.

ASSEMBLIES AFFECTED

124-000260 Repeat Oscillator was removed and replaced with 124-000360 Autochord Board. 124-000211 Mixer Board #2 was removed and replaced with 124-000374 Mixer Board #2. The cable assembly associated with the new boards is 011-046918.

CIRCUITS AFFECTED BY CHANGE

Pedal Snubber Circuit - This circuit was previously located on a terminal strip on the manual shelf between the Pedal Filter Board 124-000206, and the Bright Wave Percussion #2 Board, 124-046769-001. The circuit now is included on the 124-000360 Autochord Board.

PEDAL GAIN

The pedal gain control was previously located on the 124-000211 Mixer #2 Board. It is now located on the 124-000360 autochord board,

PEDAL VIBRATO AND TREMOLO

Earlier circuitry caused the pedal signal to be mixed into the circuit on the Mixer #2 Board at a point which would not allow for Vibrato or Tremolo effects to be added to the pedals. The revised circuit causes the pedal signal to be mixed into the circuit on the 124-000360 Autochord Board. The pedal and accompaniment output from the 124-000360 Board are connected to the lower manual Tremolo tab where the pedal, along with the accompaniment, can be switched into the Tremolo channel. (The low pedal frequencies are kept out of the Tremolo speaker by the High pass filter on Mixer Board #3).

Pedal tones will also be affected by the Vibrato 2 and 2 tabs in new Concorde circuitry.

ORGAN LEVEL SETTINGS

The level adjustments have undergone change as a result of this production change as well. See the "Test and Adjustment Procedures" on the following pages.

PEDAL 8' AND 16' NULL SETTINGS

The new circuitry on the 124-000360 Board has eliminated the need for null settings for pedal 8' and 16'. The only null adjustment remaining is for lower manual accompaniment.

- IMPORTANT -

Due to the complexity of this change, it is NOT recommended that Revisions of instruments manufactured prior to serial #376837 be attempted.

CONCORDE 2100 SERIES

TEST AND ADJUSTMENT PROCEDURES

(FOR SERIAL NO. 376837 AND ABOVE)

STEP	TEST AND TEST POINT	DEPRESS TAB OR PRESET KEY OR EXTEND TONE BARS	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER INDICATION	FIGURE
1	Power Supply Voltage Terminal Strips Behind Swell Housing			R-7 (124-000209 Bd) R-17 (124-000209 Bd) R-27 (124-000209 Bd) R-37 (124-000209 Bd)	+25 Volts - Red -28 Volts - Violet -14 - Gray -8 - White	4-15
2	Main Channel Level Across Main Speaker	U/M A# Preset All Tone Bars Brilliance	Key #25 Upper Manual	R-22, Main Adj. (124-000212) Main Channel	3.0 Volts RMS	4-7
3	Upper Manual Cut-off U/M Mother Board 124-000223-002 (U/M 380 Assembly)	Same As Step 2 Add, Sustain To Foot Switch Tab And Engage Left Switch On Swell Pedal	Key #25 Upper Manual	R-8 (124-000223-002) Main Channel	2.5 Volts Maximum D.C. Bias if Audible Feed-Thru, Reduce Bias .5 Volt Just Below Feed-Thru Point	4-17
4	Minimum Swell-Main Channel Across Main Speaker	U/M A# Preset All Tone Bars Brilliance	Key #25 Upper Manual	Expression Pedal To Minimum Main Channel	90 to 180M.V.	4-4
5 (a)	Lower Manual Ear	(Acc.) Null Adjust Rhythm 3 Settings Tempo-Mid Rate Vol. - Minimum Sil/Snd - To Sound Auto/Acc To Auto Rock & Roll		R-18 Acc. Null (124-000360 Bd.)	Minimum Audible Thump	4-19
6	Lower Manual Level Balance Across Main Speaker	L/M A# Preset All Tone Bars Brilliance	Key #25 Lower Manual	R-13-Man. Bal. (124-000210 Bd)	3.0 Volts RMS	4-19
7	Lower Manual Cut-off L/M Mother Board 124-000223 (L/M 380 Assembly)	Same As Step 6 Add Lower Sustain	Key #25 Lower Manual	R-8 (124-000223 Bd)	Turn Cut Off Pot. Until Feed- Thru is Just Audible. Reduce Bias .5 Volt Below Feed-Thru Point	4-17
8 (a)	Leslie Channel Level P-3 Term 5 On Power Supply (Leslie Channel)	L/M A# Preset Leslie Lower All Tone Bars Brilliance	Key #25 Lower Manual	R-51-Adj. Leslie (124-000212 Bd)	4.2 Volts RMS	4-7
(b)	Minimum Swell-Leslie Channel As In Step 8(a)	As In Step 8(a)	Key #25 Lower Manual	Expression Pedal To Minimum	100 to 200 M.V.	4-4
9 (a)	Reverberation Level Across Main Speaker	U/M A# Preset Leslie Upper Tone Bar Setting 000607080	Press 5 Keys 25,26,27,28, 29	R-20 Reverb Unit 124-000166	1.0 Volts RMS	4-15

STEP	TEST AND TEST POINT	DEPRESS TAB OR PRESET KEY OR EXTEND TONE BARS	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER INDICATION	FIGURE
9 (b)	Ear	Reverb 1 As In Step 9 (a)	Any Upper Manual Key	Listen For Vibrato On Reverb. (Disconnect Leslie Speaker If Necessary) Note, That Choral Tab Cancels Vibrato On Reverb. Turn Off Leslie Upper, And Note That The Amount Of Reverb Remains The Same.		
10 (a)	Bright Percussion Level Across Main Speaker	U/M B Preset Perc. FF Repeat Pizzi 1, Pizzi 2 Banjo Harsichord Piano	Key #25 Upper Manual	R-17, Bright Level Adj. (124-000208)	4.0 Volts RMS	4-19
(b)	Across Main Speaker	Repeat Rate-Maximum As In Step 10 (a) Turn Off Perc. FF Tab.	Key #25 Upper Manual		2. To 2.5 Volts RMS	
11	Repeat Null and Rate Ear	U/M B Preset Repeat Perc. FF Repeat Rate-Mid-Range	Any Upper Manual Key	R-28 Null Adj. (124-000208 Bd)	Adjust To Minimum Audible Thump (Repeat Rate Control Varies From 2 to 15 Cps.)	4-19
12 (a)	Piano Solo Level Ear	U/M B Preset Perc. FF Piano	Key #25 Upper Manual		Listen And Note Output Level	
(b)	Ear	Add Piano Solo	Key #25 Upper Manual	R-69, Solo Level (124-000208 Bd)	Listening, Adjust Output To Level Heard In 12 (a)	4-19
13 (a)	Synthesis Percussion Level Across Main Speaker	U/M B Preset Repeat Perc. FF Percussion 1 thru 8 Glock Xylophone Marimba Repeat Rate-Maximum	Key #25 Upper Manual	R-44, Synthesis Level Adj. (124-000208 Bd)	2.8 Volts RMS	4-19
(b)	Percussion Cut-off Across Main Speaker	Same As Step 13 (a) But, Turn Off Perc. FF	Key #25 Upper Manual		0.96 To 1.24 Volt RMS	
(c)	Measure Bias On Jumper Wire Near Cut Off Pot, On 124-046769 Bd.	Same As Step 13 (b)	Key #25 Upper Manual	R-22 Cut-Off Adj. (124-046769 Bd)	Turn Cut Off Pot Until Feed Thru Is Just Audible. Reduce Bias To .5 Volt Below This Feed-Thru Point	4-7
14	Pedal Level-Main Channel Across Main Speaker	Tone Bar-Pedal 16' Tone Bar-Pedal 8'	Pedal #13	R-31 Pedal Gain (124-000360)	8 Volts RMS	4-17
15	String Bass Level Across Main Speaker	String Bass	Pedal #13	R-39 String Bass Adj. (124-000206)	10 Volts P/P	4-7

STEP	TEST AND TEST POINT	DEPRESS TAB OR PRESET KEY OR EXTEND DRAWBARS	PLAY KEYS	ADJUST	OSCILLOSCOPE OR OTHER INDICATION	FIGURE
16 (a)	Hum Level's Across Main Speaker (Main Channel)	Leslie Chorale Brilliance Lights On	No Keys Or Pedals		30 MV Maximum (Hum Level)	
(b)	P-3 Term 5 On Power Supply (Leslie Channel)	Leslie Tabs On	No Keys Or Pedals		15 MV Maximum (Hum Level)	
17	Rhythm III - High Frequency Level Across Main Speaker	Snare Drum Lower Switch Volume To Maximum (CW)	Any Lower Manual Key Approx. 5 Times Per. Second	R-129-High Freq. Gain (124-000180 Bd) On Rhythm Assembly	2.7 to 3.3 Volts	4-25
18	Rhythm III - Low Frequency Level Across Main Speaker	All Rhythm Tabs Off Sil/Sound To Sound Temp To Maximum (CW)	(Bass Drum Is Heard)	R-116-Low Freq. Gain (124-000180 Bd On Rhythm Assembly)	35 Volts P/P	4-25
19 (a)	Rhythm III - Brush Measurement Across Main Speaker	Brush Switch	Any Lower Manual Key Approx. 5 Times Per Second		Brush Measurement 2.2 To 2.8 Volts	4-25
(b)	- Cymbal Measurement	Turn Off Brush Turn On Cymbal	Any Pedal Approx. 5 Times Per Second		Cymbal Measurement 2.2 To 2.8 Volts	
(c)	- Bass Drum Measurement	Turn Off Cymbal Turn On Bass Drum	As In Step 19 (b)		Bass Drum Measurement 45 to 60 Volts P/P	

The following conditions must be maintained, except for specific instructions in the adjustment procedures.

- A. All output voltages and frequencies are measured across the main speaker terminals, unless noted otherwise.
- B. Keys, pedals, and drawbars are called out by number from left to right.
- C. All tabs and presets in the up or off position and all drawbars pushed in when starting each test step.
- D. Position 8 is required when a drawbar is pulled out.
- E. Rhythm pushbuttons and control tables in the off position (up), except the WALTZ pushbutton (down).
- F. When applicable, Cassette Recorder controls in the off or minimum positions.

CHART FOR CHECKING BY COMPARISON PRESET AND TAB VOICES VARIOUS TONE BAR SETTING

UPPER MANUAL			LOWER MANUAL		
PRESET KEYS	TONE BAR SETTING	TONE QUALITY	PRESET KEYS	TONE BAR SETTING	TONE QUALITY
C		Cancel	C		Cancel
C#	00874000	French Horn 8'	C#	04545440	Cello 8'
D	008408004	Tibias 8'	D	004432000	Dulciana 8'
D#	008080840	Clarinet 8'	D#	004800000	Vibra Harp
E	088800880	Novel Solo 8'	E	002500234	Vox 8' & Tibia 4'
F	608088000	Theater Solo 16'	F	006554322	String Accomp. 8'
F#	004685300	Oboe Horn	F#	005642200	Open Diapason 8'
G	608807006	Full Tibias 16'	G	007656311	Full Accomp. 8'
G#	006888654	Trumpet 8'	G#	008030000	Tibia 8'
A	768878667	Full Theater Brass 16'	A	847767666	Bombarde 16'
A#	Adjust Tone Bars for 1st Group, Upper Manual		A#	Adjust Tone Bars for 1st Group, Lower Manual	
B	Adjust Tone Bars for 2nd Group, Upper Manual		B	Adjust Tone Bars for 2nd Group, Lower Manual	

UPPER MANUAL CONTROL TAB VOICES

CONTROL TABS	TONE BAR SETTING	HARMONIC TONE BAR
Percussion 1	008000000	Fundamental
Percussion 2	000800000	2nd Harmonic
Percussion 3	000080000	3rd Harmonic
Percussion 4	000008000	4th Harmonic
Percussion 5	000000800	5th Harmonic
Percussion 6	000000080	6th Harmonic
Percussion 8	000000008	8th Harmonic
Glock	800800800	Sub Fundamental, 2nd & 5th Harmonic
Xylophone	000800080	2nd & 6th Harmonic
Marimba	008008000	Fundamental & 4th Harmonic
Piano	008654321	Fundamental, 2nd, 3rd, 4th, 5th, 6th, 8th Harmonic

Cassette: The inbuilt cassette works essentially as on the T-500 and Phoenix models.

One exception is that when recording, the reverb added to the music is not recorded, but anything played back from the cassette may have reverb added by the reverb tabs.

The Leslie effect cannot be directly recorded, however, using the microphone held near the center of the organ grille and about three feet away, will record both the Leslie and direct speakers.

Expression Pedal Side Switches: The left foot switch (as long as it is held) cancels tones channeled to the Leslie and diverts them to the stationary speakers.

The right foot switch cancels the rhythm tones.

Phone Jack: Jack is located under the lower manual on the right. No Stereo/Mono adapter is needed.

Phono Input: is provided (on amp chassis) as on other products for use with external signal-generating devices. Input impedance is 50K ohms, and maximum signal acceptable is 0.25 volts R.M.S.

Power Output: is derived from two power amplifiers rated at 35 watts R.M.S. each.

Speaker Compliment: includes a fifteen-inch woofer, a six-inch speaker, and a six-by-nine-inch oval speaker in the Leslie Rotosonic.

SERVICE INFORMATION

Vital Voltages - Tie points located on Terminal Tab strips mounted on bottom shelf behind Swell Pedal Housing.

Voltage and Color of Wire

-25V	Red Leads	GND.	Black Leads
GND.	Black Leads	-8V	White Leads
-28V	Violet Leads	-14V	Gray Leads
GND	Black Leads		

Tone Bar Voltages

0 to -1 volts: magnitude of output depends on tone bar setting. If you have a tone bar cypher, measure tone bar voltages. It should read 0 (zero). If it does not read 0 (zero), change the transistor associated with the bad tone bar.

There are four generation systems:

Three are similar:

1. Synthesis Percussion 124-000223 Board, 380 IC's, gives square wave-out.
2. Upper Manual 124-000223 Board, 380 IC's, gives square wave-out.
3. Lower Manual 124-000223 Board, 380 IC's, gives square wave-out.

and

4. Bright Percussion, two boards (124-046769 and 124-046769-001) with three IC's per board, generate staircase signal.

MDD - 124-000266 board on lower right gives 13 square waves of Frequencies 85 to 97.

These feed four generating systems:



The cabling is in series through the boards.

Sync. or clears are signals used to coordinate all the generation systems so that all signals are in phase.

On the mother boards, J-110 is the MDD signal input

J-109 is the Sync. signal input

You need both MDD signal and sync. signal to get tones out of the system.

*Upper Manual

MDD signals go to J-110 plug to proper daughter board

On the mother board J-114, J-116, J-117 are marked with key numbers.



* The filter boards are located on the Top-Back. These filter boards change the square wave to sine waves. All sine waves signals from 124-000201 and 124-000204 board go through 124-000202 board and to Mixer #2 Board, 124-000211, and the through Brilliance Amp, to the Leslie switch, to Main or Leslie amp, where it is mixed with the lower manual signals, then out of the 124-000211 board to the Vibrato tabs, then back to the 124-000211 board (for Vibrato or Non-Vibrato), then to the Expression Pedal Amp, to the Mixer #3 Board, 124-000212 and on to the final Pre-amp, with main signal to Echo tabs to Main Power Amplifier to the earphone jack and speakers.

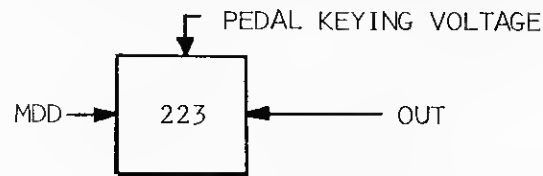
With the Leslie tab down, the signal goes back to Mixer #2 Board 124-000211, to the Leslie channel on Mixer #3 Board 124-000212, then to the Leslie speaker through a high pass filter.

*Lower Manual

Similar to Upper Manual in function with the addition of the Autochord function. The lower manual signal goes to Mixer #1 Board, 124-000211 to mix with upper manual signal. Leslie channel is bridged to Vibrato Board and Mixer #3 Board 124-000212 and Reverb Channel.

*Pedal Signal

The Pedal Signal is generated on the lower manual mother board.



J-111 and J-112 on lower manual mother board are pedal keying voltages.

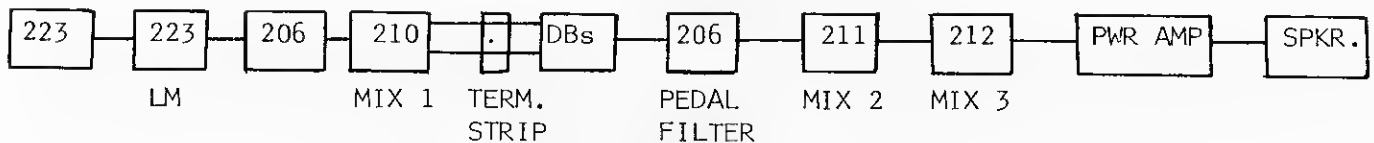
Output is square wave to the pedal filter board 124-000206

to 16' gate, to pedal terminal strip, to the 16' tone bar then

to 8' gate, to pedal terminal strip, to the 8' tone bar then back to (Q9) on pedal filter board, 124-000206, to Mixer #2 board, 124-000211 where it is mixed with the Main Channel.

There is no Vibrato or Leslie on Pedals.

Pedal Signal Path.

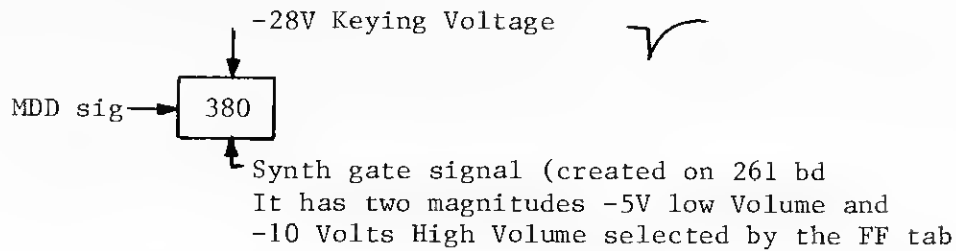


* PERTAINS ONLY TO MODELS PRIOR TO SERIAL NO. 376837.

380 IC SYSTEM

Upper and Lower Manual

Synthesis Percussion requirements

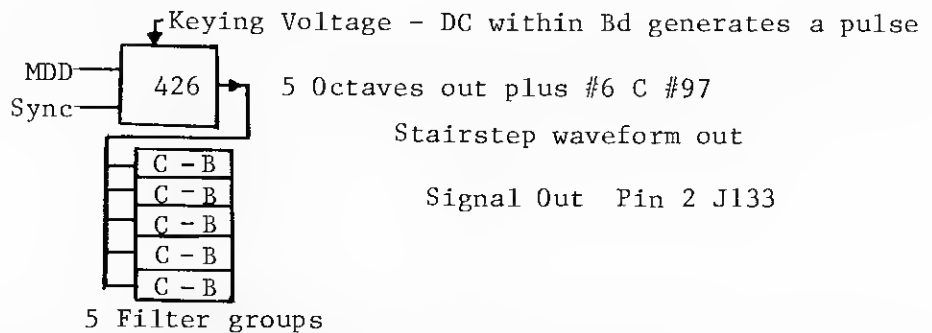


On the Synthesis Percussion Board, Plug marked DB is actually Synthesis Gate Signal.

Synthesis Percussion Filter, 124-000201, 202, 204, are on left bottom behind reverb assembly. Pin 11 of 124-000202 board is summation of all percussion signals, that now go to the bright percussion board, 124-000208 (all percussion signals go through this board). 124-046759 board provides all percussion keying.

426 IC SYSTEM

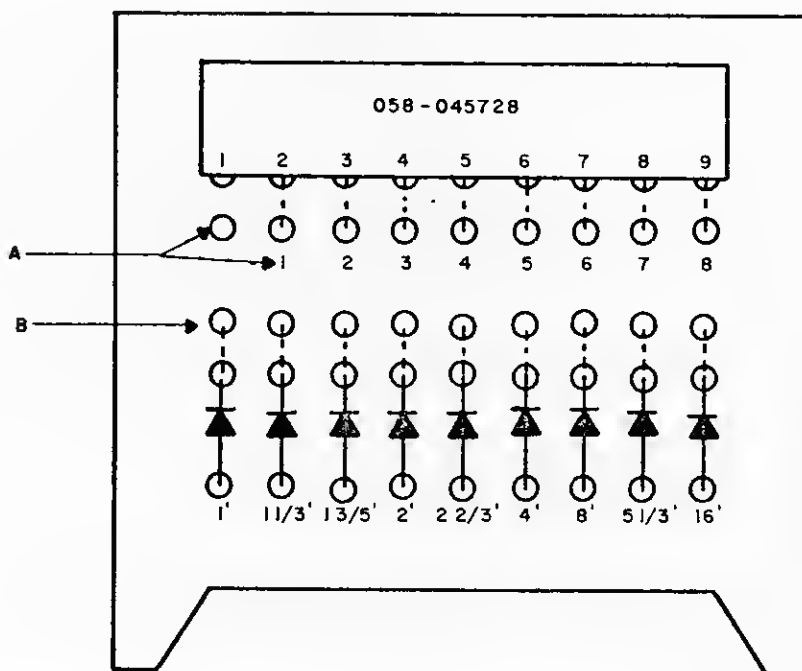
Bright Percussion System



Preset Keys: Are labeled and operated as on past Hammonds with a few exceptions: One or more keys can be latched at a time, combining tones.

On other Hammonds the 18 presets have been changeable by rearranging multi-colored wires on preset rack inside back of organ. On the Concorde, these tones are factory set by 18 different plug-in printed circuit boards. The owner may obtain one or more substitute interchangeable boards on which a serviceman may simulate any desired tone. Any preset changes may conflict with tone names stamped on preset keys.

UNIVERSAL PRESET BOARD ASSEMBLY INSTRUCTIONS



Refer to the included illustration for location or position to install jumpers which are included as part of kit #103-00505.

The lower numbers in Row A indicate the tonebar intensity levels. The harmonic tonebar footages connected through diodes appear at Row B. To create any desired tone color, install jumpers between Row A and Row B as follows.

In explaining the method of wiring the universal preset board for a tonebar selection of your choice, we will select the Voicing for Diapason 16' in which the tonebar setting is 643322000.

Install the jumpers in the following manner:

- a. Place jumper from 16' diode Row B to intensity level 6 Row A.
- b. Place jumper from 5-1/3' diode Row B to intensity level 4 Row A.
- c. Place jumper from 8' diode Row B to intensity level 3 Row A.
- d. Place jumper from 4' diode Row B to intensity level 3 Row A.
- e. Place jumper from 2-2/3' diode Row B to intensity level 2 Row A.
- f. Place jumper from 2' diode Row B to intensity level 2 Row A.
- g, h, & i

The tonebar level for 1-3/5', 1-1/3', and 1' are zero therefore no jumpers need to be installed.

NOTE: In some cases more than one jumper lead may be placed in an intensity level hole of Row A.

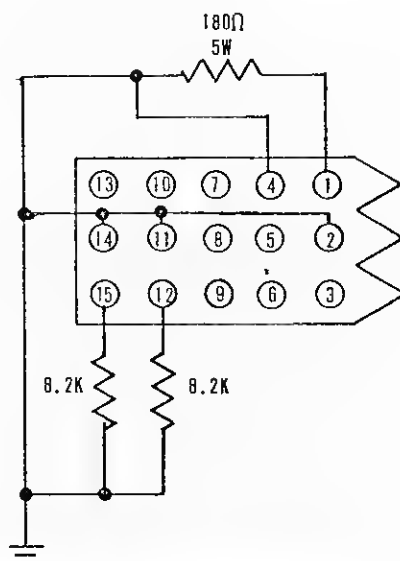
Solder all jumpers and insert board in proper preset location.

SUBJECT: RHYTHM III (124-000082) SUBSTITUTION PLUG

Purpose is to operate organ with Rhythm III removed.

Parts needed:

One Female Plug	004-030973
Seven Female Pins	007-030734
Two Resistors (8.2K)	600-020711
One Resistor (180Ω5W)	604-070121



SUBJECT: TERMINAL REPAIR AND P.W.B. EDGE CLEANING

Terminal Repair

Once a terminal has been crushed, the shape of the tip on which proper operation depends has been distorted. It is necessary that a terminal be replaced not merely straightened. Pin part number is 007-043171.

P.W.B. Edge Cleaning

Flux or tape residue contamination of the P.W.B. edge fingers can result in an unreliable connection with time in the field. The solder or tin coating on some boards are very thin, so care must be taken not to expose the copper in cleaning the edge of a board. Copper will always oxidize with time which can result in unreliable or bad connection. Try cleaning the board edge first with a solvent. If a solid connection is not obtained, and tarnish is present; remove it with a non-abrasive rubber eraser. Suggested solvents are:

To remove tape residue-Cleaner's Naptha
To remove flux-Reliasolve or Isopropyl-
Alcohol (Isopropanol)

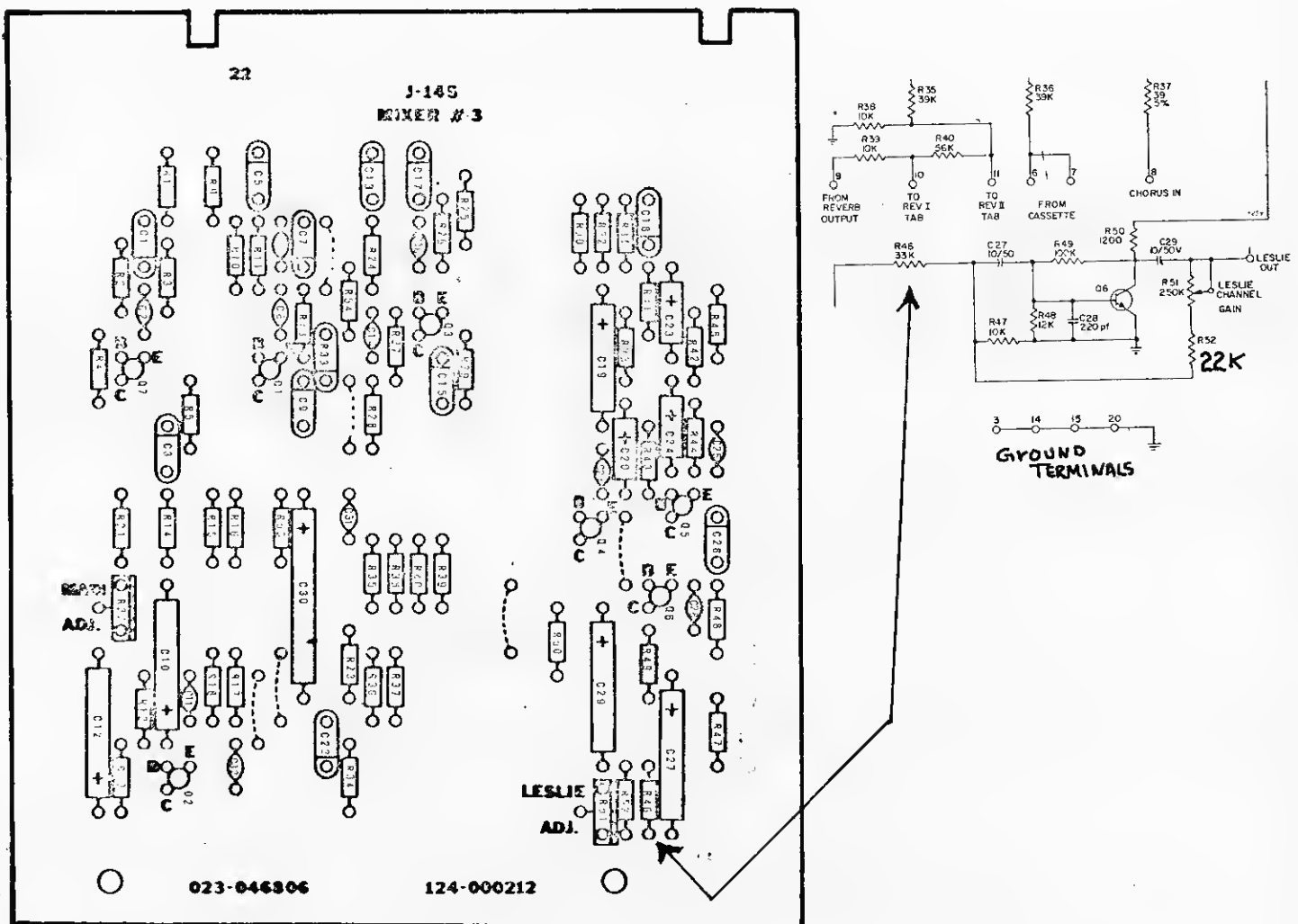
Model CONCORDE
2100

SUBJECT: HIGH GAIN - TREMOLO CHANNEL

SERIAL 376837 AND ABOVE

SYMPTOM: Unable to adjust Tremolo Gain (Leslie Gain) Control R51, on 124-212 Mixer #3 PWB low enough to meet Specs.

CORRECTION: Check value of R46 on 124-212 Board. Change from 22K to 33K and readjust R51 to 4.2 volts RMS as per set up chart.



SUBJECT: PEDAL KEYING CAUSES WHITE NOISE OR HISS
FEED THROUGH

Model CONCORDE
2100

SERIAL 376837 AND ABOVE

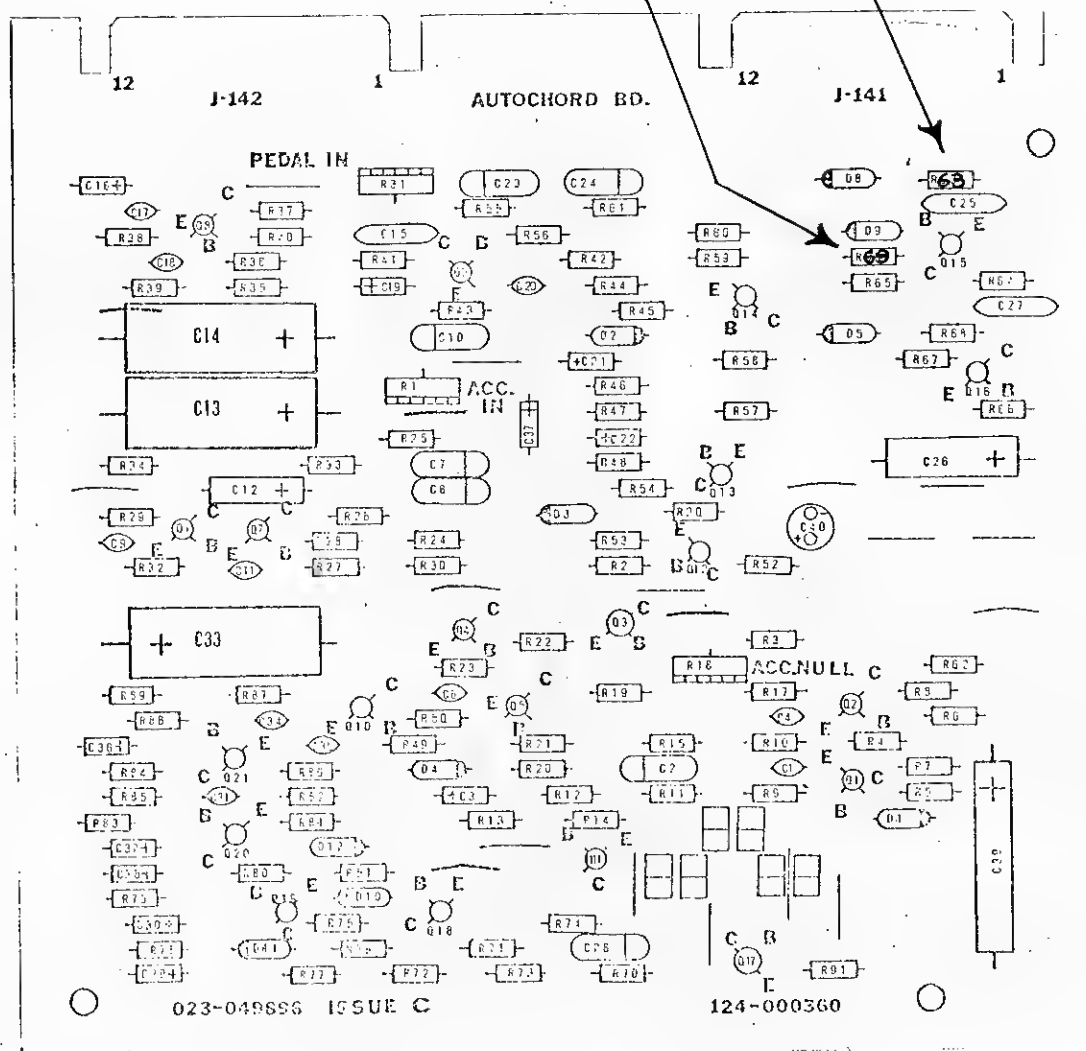
SYMPTOM: Upper B-Preset depressed, any synthesis percussion tab depressed, Brilliance tab depressed.

Depress any pedal - subject feed thru.

CORRECTION: On 124-360 Autochord Board -

Change R63 from 220K to 100K

Change R69 from 22K to 15K.



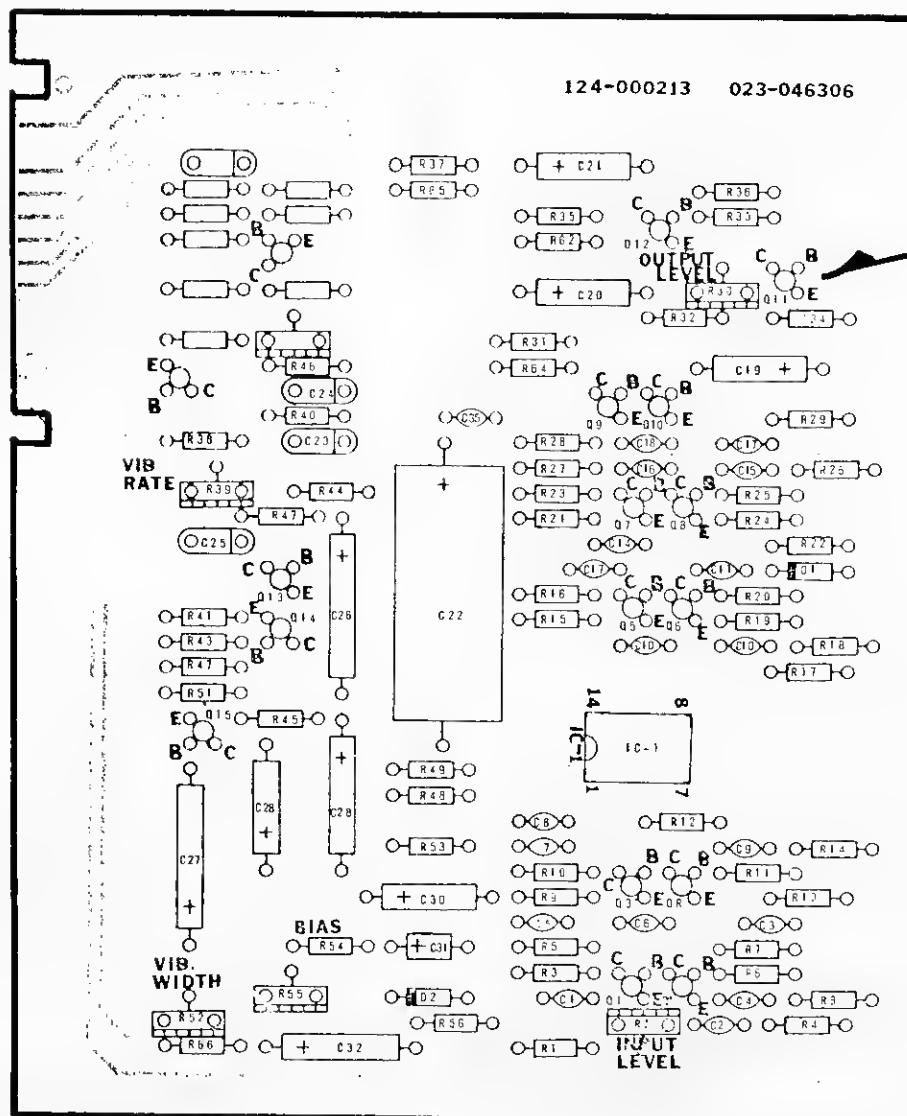
SUBJECT: SECONDARY TURN ON TRANSIENT

This secondary thump or turn on transient may be more noticeable with the Vibrato Tabs or the Reverb Tabs depressed.

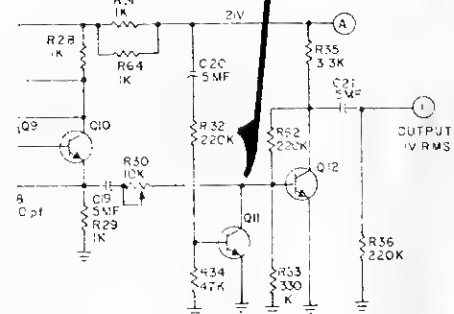
The delayed switching on of Q11 on the 124-000213 Vibrato PWB may be the source of this transient.

CORRECTION: Disable Q11 either by removing it from the circuit Board or by clipping the collector lead (C).

NOTE: There are two (2) 124-000213 Boards in the Concorde. One is located on the underside of the top panel assembly. The other is beneath the manual shelf in the 15" Bass Speaker Enclosure. Q11 on each Board should be disabled.



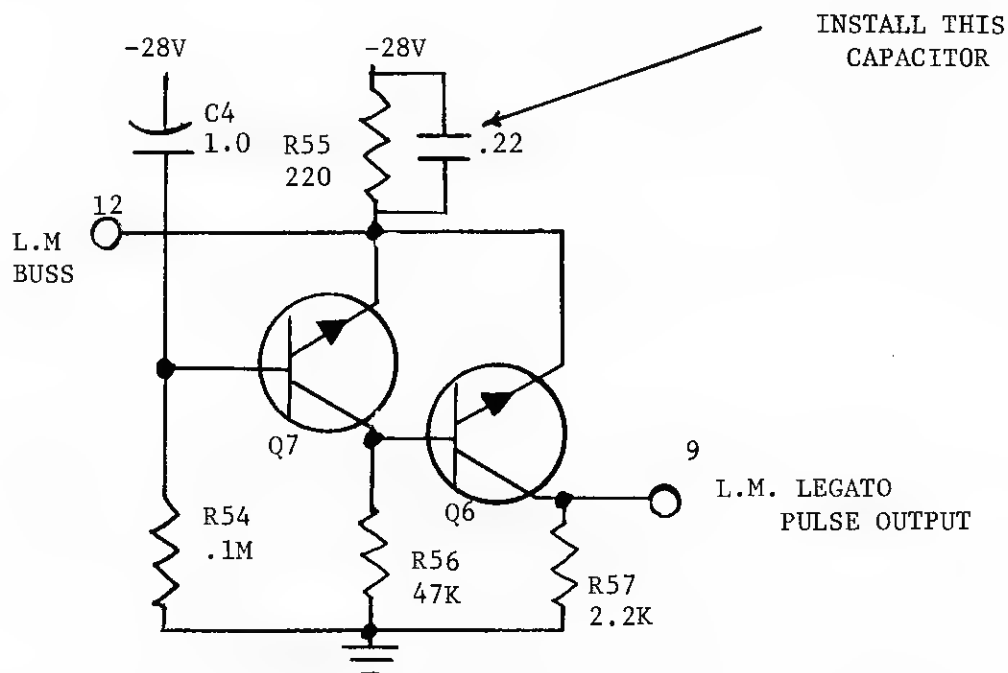
Q11 LOCATION



SUBJECT: DOUBLE KEYING OF LOWER MANUAL
RHYTHM VOICES

To reduce double keying of the Snare Drum and/or Brush voices when keyed by lower manual, the following change is recommended.

1. Install a .22 capacitor across R55 in the lower manual legato pulse generator circuitry as shown below.
2. Change C4 from 4.7 MFD to 1.0 MFD.

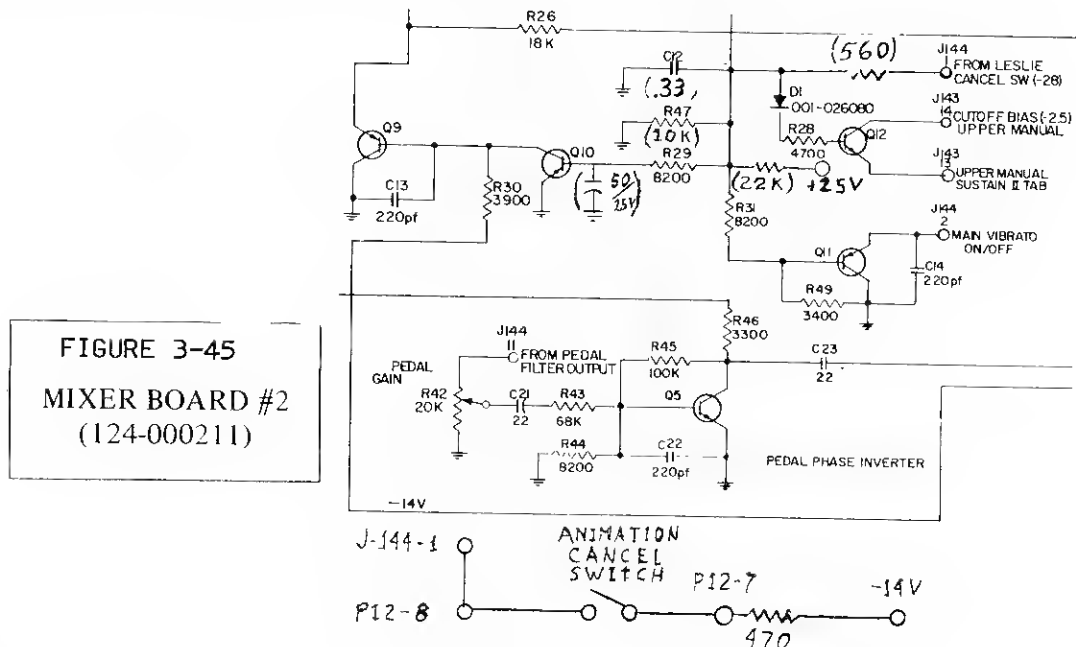


LOWER MANUAL LEGATO PULSE GENERATOR

SUBJECT: ANIMATED CANCEL SWITCH POP

Refer to drawing below. On Mixer #2, 124-000211, cut the foil leading into the board from J44-1 and insert a 560 ohm resistor in series. Replace C-12, a .05 disc with a .33 microfarad mylar capacitor. Change R-47 from 2700 ohms to 10K ohms. Between the 25 volt terminal and the junction of C-12 and the new 560 ohm resistor, add a 22K ohm resistor. Connect a 50 or 100 microfarad, 15WVDC or more capacitor from the base of Q-10 to ground. (Positive lead to base and negative lead to ground).

The violet wire from Pin 7 of the swell pedal plug must be disconnected from -28V and connected to -14V through a 470 ohm resistor.

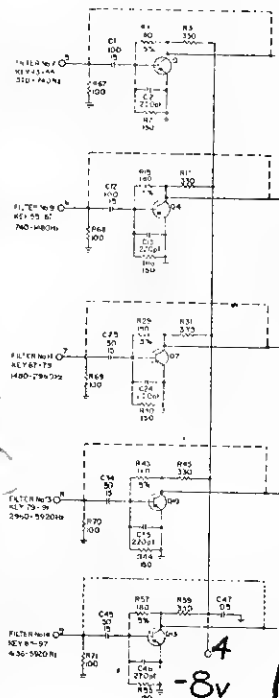


SUBJECT: FREQUENCY 37-96 LOW OUTPUT

SYMPTOM: The most noticeable effect will be the loss of high frequency response.

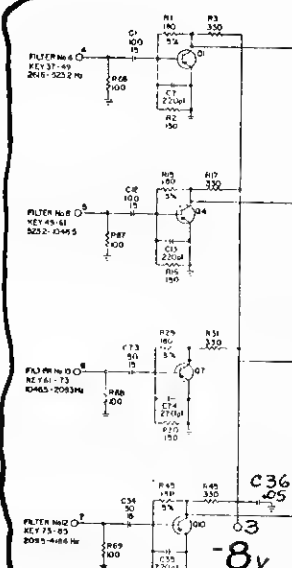
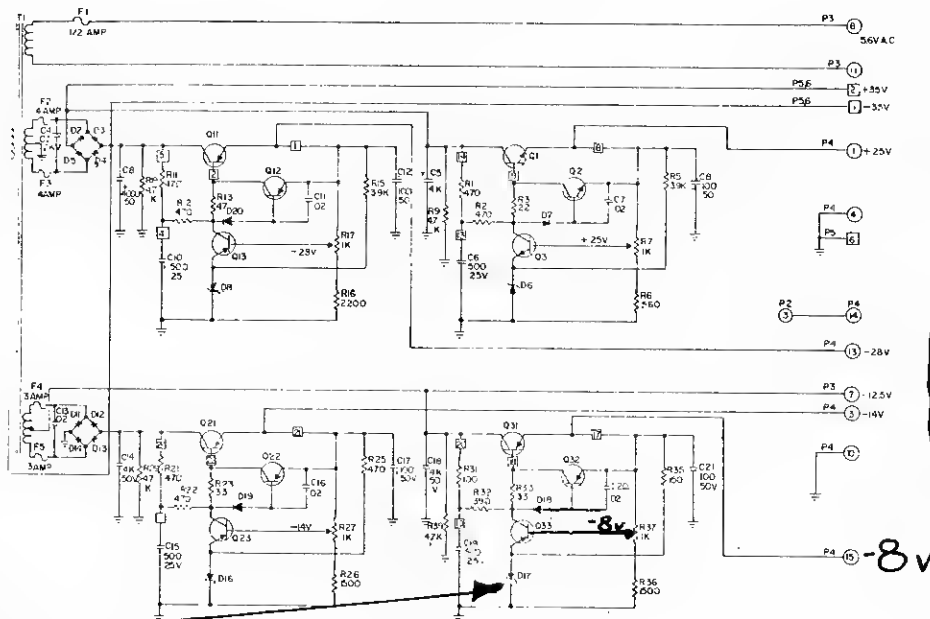
CORRECTION: On Filter Boards 124-202 and 124-204 (there are 3 each in Concorde), -8 volts from Power supply feeds the single stage preamps for each Filter group. The absence of, or reduced level of the -8 volt supply will cause low amplitude of signal in the filter.

Check for defective D17 (5 volt Zener), 001-023030 (located on 124-209 PWB) on Power supply.

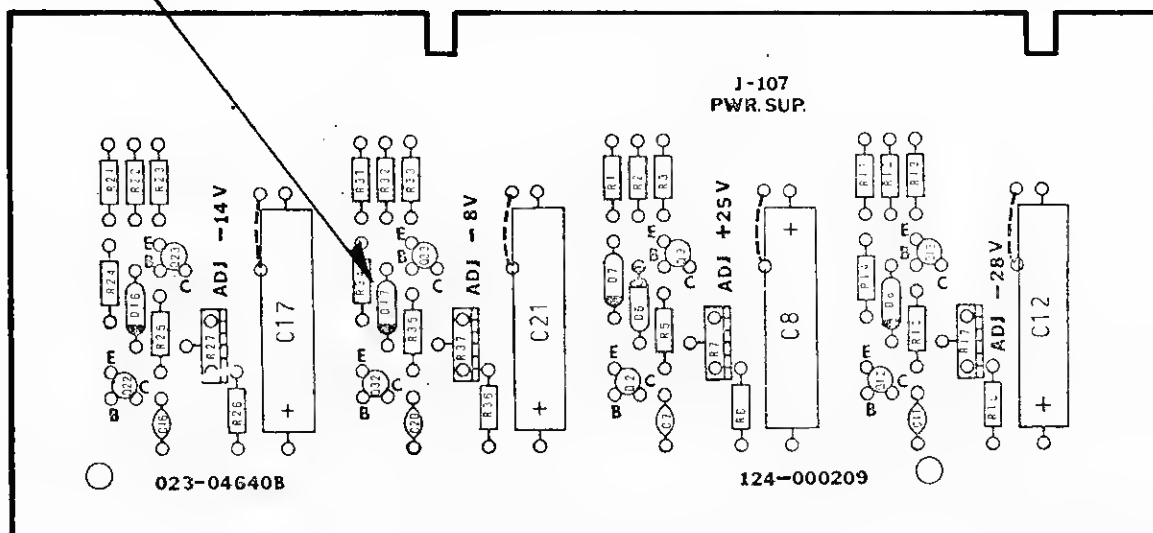


SINE FILTER BOARD
(124-0002-01)

D17



SINE FILTER BOARD
(124-0002-02)



023-046408

124-000209

Model: 2100,

SUBJECT: TELEVISION INTERFERENCE

There have been reports of Sine Filter boards causing interference to television sets, especially channel 2, and 4. In the event that one of the sine filters is found to be causing the T V I, the following steps should be taken.

1. Make sure all polystyrene capacitors on the sine filter boards are installed properly. The color strip should be the end opposite to the positive (+) marking on the legend.

2. Install 100 pf ceramic disc capacitors from the base to emitter of the output emitter followers on the following PWB.

A) Q2, Q4, Q6, Q8, and Q10 on 124-000201,

B) Q3, Q6, Q9, and Q12 on the 124-000202,

C) Q3, Q6, Q9, Q12, and Q14 on the 124-000204,

These capacitors may be soldered on the back or front of the PWB. The leads should be as short as possible and directly across the transistor leads, because the Concorde has (9) nine of these sine filter boards. It would be advantageous to determine which filter boards are causing the problem and only modifying those necessary.

SUBJECT: CONCORDE TROUBLESHOOTING HINTS

Model: 2100

1. Fuzzy , intermittent or number of pedals dead.

In the pedal switch assembly the -28V buss is connected by bar segments; if they are not tight fitting, the above symptom will prevail.

2. Locating ciphers in filter boards.

If a cipher has been found to exist in a filter board, the circuit involved can quickly be located by squeezing the individual transistors between the thumb and first two fingers. The added body capacitance changes the frequency of the cipher thereby indicating the filter at fault.

3. Random note failure and then total loss of organ.

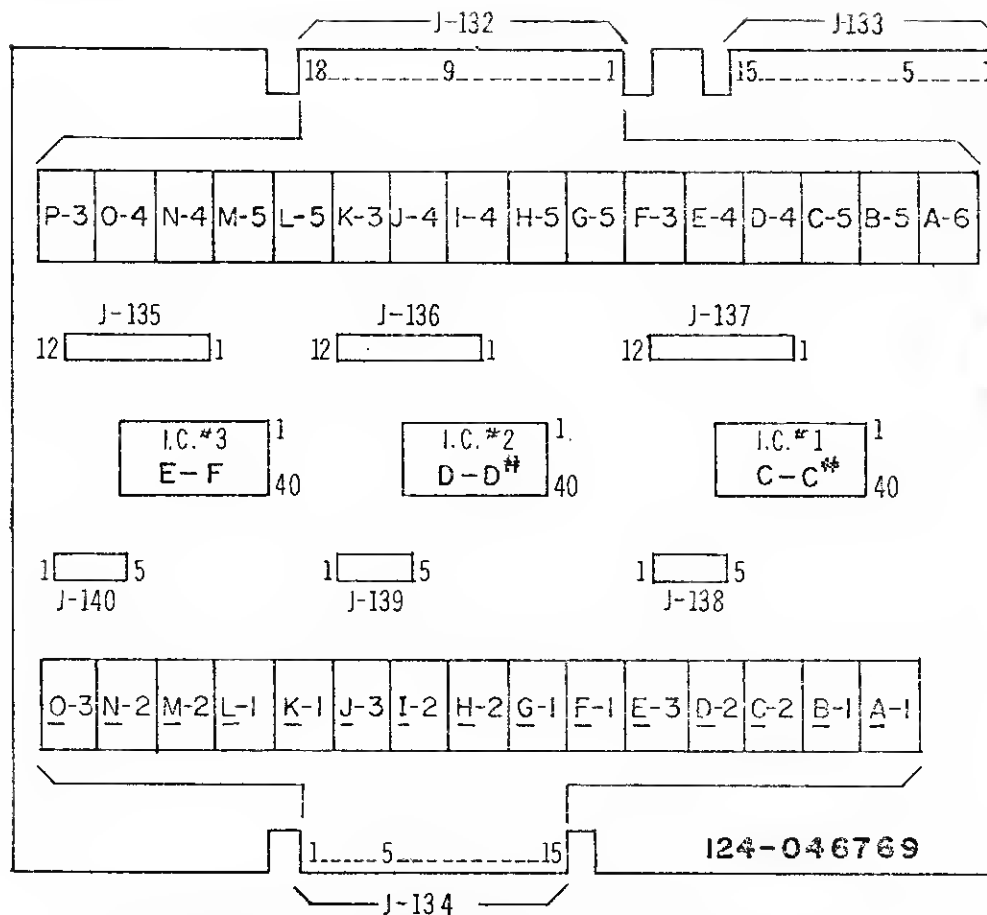
This symptom occurs after taking back of organ off and plugging organ back on, everything seems normal until back is put on. Check D6 on 124-000266 MDD board.

4. Cipher occurrring when Piano Solo tab depressed.

Removing plugs from 124-000202 of upper, lower, and polysynthesis does not clear cipher. Check for voltage at C2 capacitors of Bright Wave percussion board. There should not be any; if there is, check D3 of the section.

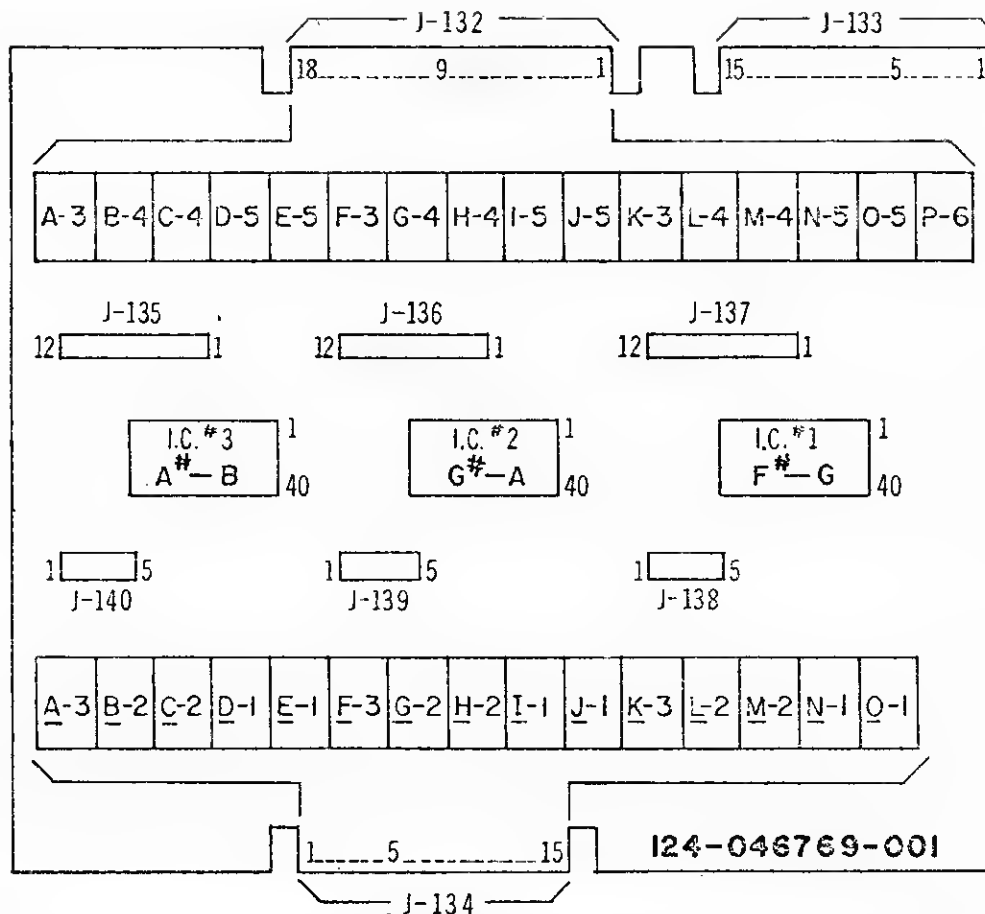
5. Cipher on upper manual corresponding to a specific tone bar footage.

Removing the J131 plug of the upper manual preset mother board, does not remove it. With plug removed, check to see if a voltage (negative) can be measured on that footage. Remove daughter boards one by one until cipher is removed. Check clamping diode for that tone bar for leakage or short.



KEY, FREQUENCY, PLUG AND CIRCUIT LOCATION CHART

KEY NO.	FREQ. NO.	MANUAL INPUT KEYING PLUG-PIN	WIRE COLOR	CIRCUIT LOCATION SECTION	BRIGHT PERC. OUTPUT PLUG-PIN	KEYING OUTPUT TO SYNTHESIS PERC. PLUG-PIN
1	13	J-134-14	BLUE	B-1	J-133-2	J-135-4
2	14	J-134-15	GREY	A-1	J-133-2	J-138-5
3	15	J-134-10	VIOLET	E-1	J-133-2	J-139-5
4	16	J-134-9	ORANGE	G-1	J-133-2	J-139-4
5	17	J-134-5	RED	K-1	J-133-2	J-140-5
6	18	J-134-4	GREY	L-1	J-133-2	J-140-4
13	25	J-134-12	BROWN	D-2	J-133-3	J-138-2
14	26	J-134-13	ORANGE	C-2	J-133-3	J-138-3
15	27	J-134-8	RED	H-2	J-133-3	J-139-3
16	28	J-134-7	VIOLET	I-2	J-133-3	J-139-2
17	29	J-134-3	BLUE	M-2	J-133-3	J-140-3
18	30	J-134-2	YELLOW	N-2	J-133-3	J-140-2
25	37	J-134-11	GREEN	E-3	J-133-4	J-138-1
26	38	J-132-6	BROWN	F-3	J-133-4	J-137-6
27	39	J-132-11	WHITE	K-3	J-133-4	J-136-5
28	40	J-134-6	GREEN	J-3	J-133-4	J-139-1
29	41	J-132-16	YELLOW	P-3	J-133-4	J-135-5
30	42	J-134-1	BLUE	O-3	J-133-4	J-140-1
37	49	J-132-4	ORANGE	D-4	J-133-8	J-137-4
38	50	J-132-5	RED	E-4	J-133-8	J-137-5
39	51	J-132-10	BROWN	J-4	J-133-8	J-137-4
40	52	J-132-9	BLUE	I-4	J-133-8	J-136-3
41	53	J-132-15	GREEN	O-4	J-133-8	J-137-4
42	54	J-132-14	WHITE/GREEN	N-4	J-133-8	J-135-3
49	61	J-132-2	YELLOW	B-5	J-133-9	J-137-2
50	62	J-132-3	WHITE	C-5	J-133-9	J-137-3
51	63	J-132-8	GREY	H-5	J-133-9	J-136-2
52	64	J-132-7	YELLOW	G-5	J-133-9	J-136-1
53	65	J-132-13	ORANGE	M-5	J-133-9	J-135-2
54	66	J-132-12	VIOLET	L-5	J-133-9	J-135-1
61	73	J-132-1	RED	A-6	J-133-7	J-137-1



KEY, FREQUENCY, PLUG AND CIRCUIT LOCATION CHART

KEY NO.	FREQ. NO.	MANUAL INPUT KEYING PLUG-PIN	WIRE COLOR	CIRCUIT LOCATION SECTION	BRIGHT PERC. OUTPUT PLUG-PIN	KEYING OUTPUT TO SYNTHESIS PERC. PLUG-PIN
7	19	J-134-15	YELLOW	O-1	J-133-2	J-138-5
8	20	J-134-14	BLUE	N-1	J-133-2	J-135-4
9	21	134-10	GREEN	J-1	J-133-2	J-139-5
10	22	J-134-9	WHITE/BROWN	I-1	J-133-2	J-139-4
11	23	J-134-5	WHITE	E-1	J-133-2	J-140-5
12	24	J-134-4	RED	D-1	J-133-2	J-140-4
19	31	J-134-13	RED	M-2	J-133-3	J-138-3
20	32	J-134-12	WHITE	L-2	J-133-3	J-138-2
21	33	J-134-8	BROWN	H-2	J-133-3	J-139-3
22	34	J-134-7	BLUE	G-2	J-133-3	J-139-2
23	35	J-134-3	GREEN	C-2	J-133-3	J-140-3
24	36	J-134-2	VIOLET	B-2	J-133-3	J-140-2
31	43	J-132-6	RED	K-3	J-133-4	J-137-6
32	44	J-134-11	YELLOW	K-3	J-133-4	J-138-1
33	45	J-132-11	ORANGE	F-3	J-133-4	J-136-5
34	46	J-134-6	GREY	F-3	J-133-4	J-139-1
35	47	J-132-16	VIOLET	A-3	J-133-4	J-135-5
36	48	J-134-1	WHITE	A-3	J-133-4	J-140-1
43	55	J-132-5	BROWN	L-4	J-133-8	J-137-5
44	56	J-132-4	WHITE/ORANGE	M-4	J-133-8	J-137-4
45	57	J-132-10	RED	G-4	J-133-8	J-137-4
46	58	J-132-9	VIOLET	H-4	J-133-8	J-136-3
47	59	J-132-15	BLUE	B-4	J-133-8	J-137-4
48	60	J-132-14	WHITE/ORANGE	C-4	J-133-8	J-135-3
55	67	J-132-3	Orange	N-5	J-133-9	J-137-3
56	68	J-132-2	GREY	O-5	J-133-9	J-137-2
57	69	J-132-8	YELLOW	I-5	J-133-9	J-136-2
58	70	J-132-7	WHITE	J-5	J-133-9	J-136-1
59	71	J-132-13	GREY	D-5	J-133-9	J-135-2
60	72	J-132-12	BROWN	E-5	J-133-9	J-135-1

NOTE: J-132-1)
J-132-17) NOT USED
J-132-18)

MAINTENANCE

2-47 CLEANING

PLASTIC KEYS AND CONTROL TABS

Clean plastic keys and control tablets lightly with a soft, damp cloth or chamois. Wiping with a dry cloth builds up an electrostatic charge which will attract dust particles from the air. If cleaning agents are necessary, use pure facial soap and lukewarm water. Dry without excessive rubbing. Do not use boiling water, strong solvents such as alcohol, dry cleaning fluids, or window cleaning fluids which contain such solvents.

WOODWORK

Clean and dust the woodwork with a soft, damp cloth or chamois. If cleaning agents are necessary, use a soft cloth lightly dampened with a solution of mild soap and lukewarm water. Remove solution, using soft cloth dampened with clean water. Dry thoroughly, rubbing with the grain. Use a good grade liquid furniture wax or polish. Avoid use of paste waxes or oil type polishes. Excessive rubbing in one spot or at edges may result in damage to the finish.

MOVING OR SHIPPING

Arrange to have your organ properly packed by your Hammond Organ dealer if not be a regular furniture mover. Don't risk damage to the instrument by letting inexperienced movers handle it.

LOCATION OF CONSOLE

The back of the console should be at least two inches from the wall for ventilation and for the best acoustic results.

SERVICE

PRODUCT SERVICE

For product service, contact nearest authorized Hammond Service Center or write to: Manager, Product Service, Hammond Organ Company, 4200 West Diversey Avenue, Chicago, Illinois 60639.

PARTS ARE ALSO AVAILABLE BY CONTACTING PRODUCT SERVICE AS MENTIONED ABOVE.

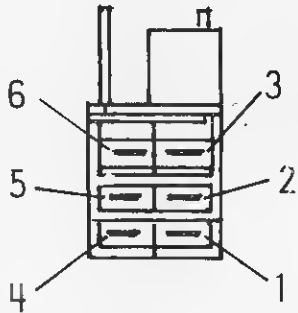
IMPORTANT:

ALWAYS SUPPLY MODEL DESIGNATION AND SERIAL NUMBER WHEN WRITING.

CONTROL PANEL TAB SWITCH ASSEMBLY WIRING CHART

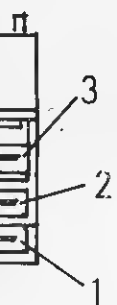
WITH TAB SWITCH IN THE UP(OFF) POSITION:
IF SWITCH TERMINAL 5 & 6 OR 2 & 3 ARE USED, THE RESULT WILL BE A NORMALLY OPEN SWITCH.

IF SWITCH TERMINAL 5 & 4 OR 2 & 1 ARE USED, THE RESULT WILL BE A NORMALLY CLOSED SWITCH.



SWITCH VIEWED FROM FRONT OF ORGAN WITH CONTROL PANEL IN THE SWING UP POSITION.

S W I T C H T E R M	REPEAT	PERCUSSION ff	PERCUSSION FAST	1	2	3	4	5	6	8	GLOCK	TWIN MALLET XYLOPHONE	TWIN MALLET MARIMBA
1	WHT/REO	ORN	NC	WHT/ORN(2)	YEL	GRN	BLU	BRN	WHT	WHT/BLK	WHT/BRN(2)	BLU	GRN
2	GRA	YEL	WHT/BRN(2)	YEL	GRN	BLU	BRN	WHT	WHT/BLK	WHT/RED(2)	BLU	GRN	WHT/BRN
3	WHT/BRN	GRA(2)	WHT/ORN(2)	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
4	WHT/RED(2)	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
5	WHT/ORN	NC	NC	GRA(2)	GRA(2)	GRA(2)	GRA(2)	GRA(2)	GRA(2)	GRA(2)	GRA(2)	GRA(2)	GRA
6	WHT/YEL	NC	NC	BRN	REO	ORN	YEL	GRN	BLU	VIO	WHT	WHT/BLK	GRN

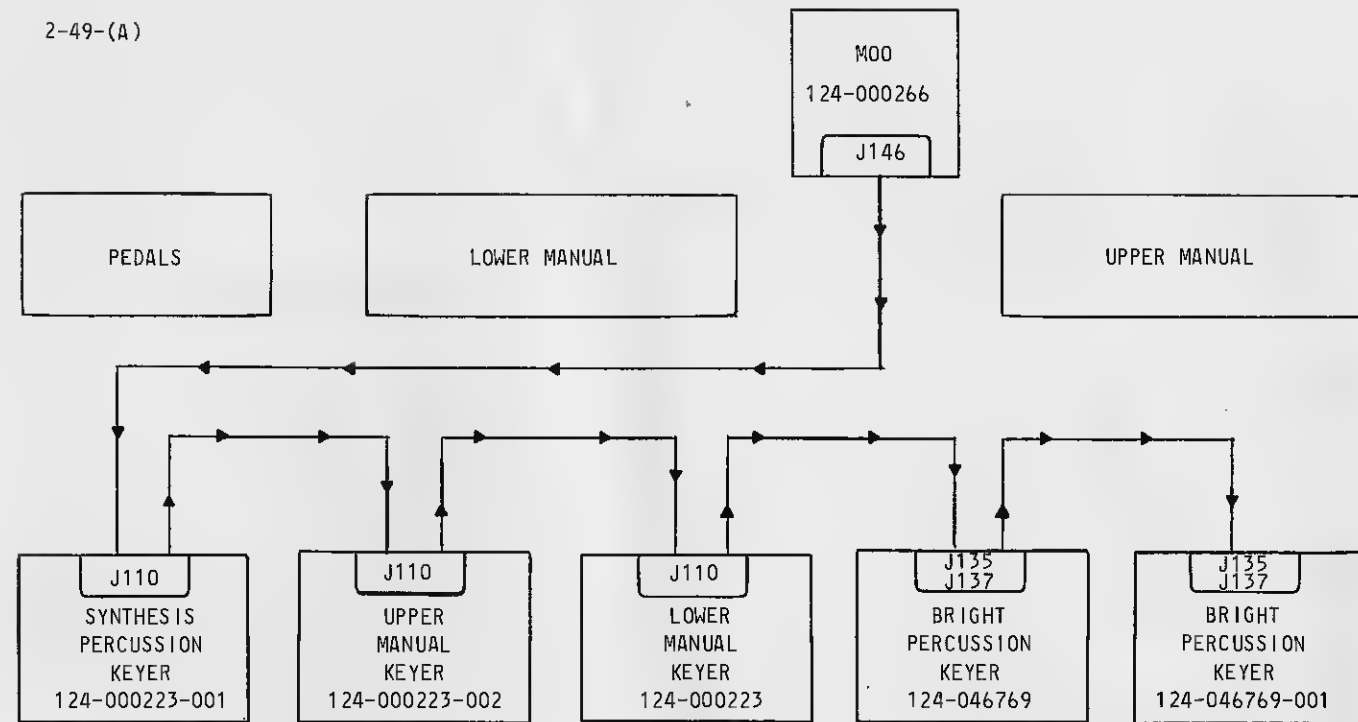


S W I T C H T E R M	PIZZICATO 1	PIZZICATO 2	BANJO	HARPSICHO	PIANO	PIANO SOLO	PEDAL SUSTAIN 1	PEOAL SUSTAIN 2	STRING BASS	LOWER TO PEOAL	SUSTAIN UPPER SHORT	SUSTAIN UPPER LONG
1	NC	NC	WHT/BRN	WHT/ORN	WHT/BRN	BRN(2)	GRN	GRN	NC	BLK	BLU	WHT/YEL
2	WHT/ORN(2)	WHT/ORN(2)	WHT/REO	BRN	WHT/REO	WHT/BRN	WHT/YEL(2)	WHT/YEL	CLEAR	ORN	WHT/YEL	GRN
3	WHT/BRN(2)	WHT/BRN	NC	NC	NC	WHT	NC	NC	RED	NC	NC	NC
4	NC	NC	NC	NC	NC	BLU	NC	NC	NC	NC	NC	NC
5	ORN(2)	ORN(2)	ORN(2)	ORN	CLEAR	WHT/YEL	NC	NC	NC	NC	NC	NC
6	CLEAR	BLU	BLU	YEL	CLEAR	NC	NC	NC	NC	NC	NC	NC

S W I T C H T E R M	SUSTAIN LOWER	SUSTAIN TO FOOT SWITCH	ACOUSTIC TREMOLO UPPER	ACOUSTIC TREMOLO LOWER	ACOUSTIC TREMOLO CELESTE	ACOUSTIC TREMOLO CHORUS	VIBRATO 1	VIBRATO 2	REVERB 1	REVERB 2	BRILLIANCE	ECHO ONLY	MAIN & ECHO
1	YEL(2)	GRN(2)	CLEAR	RED	VIO	NC	WHT/REO(2)	BLU	YEL	YEL	BLK(2)	GRN	NC
2	WHT/YEL(2)	BLU	BRN	YEL	BLK(2)	WHT/BRN	BLU	CLR(SH)	BLK	ORN	CLEAR	WHT/REO	GRN
3	NC	NC	GRN(SH)	YEL(SH)	BLK	BLU	GRN(2)	GRN	NC	GRN	NC	YEL	YEL
4	NC	NC	NC	NC	GRN	NC	NC	YEL	NC	NC	CLEAR	BRN	NC
5	NC	NC	NC	NC	WHT/BLK	NC	YEL	BLK	GRN(2)	NC	BLK	YEL	BRN
6	NC	NC	NC	NC	WHT	NC	ORN	BRN	WHT/YEL	NC	NC	REO	REO

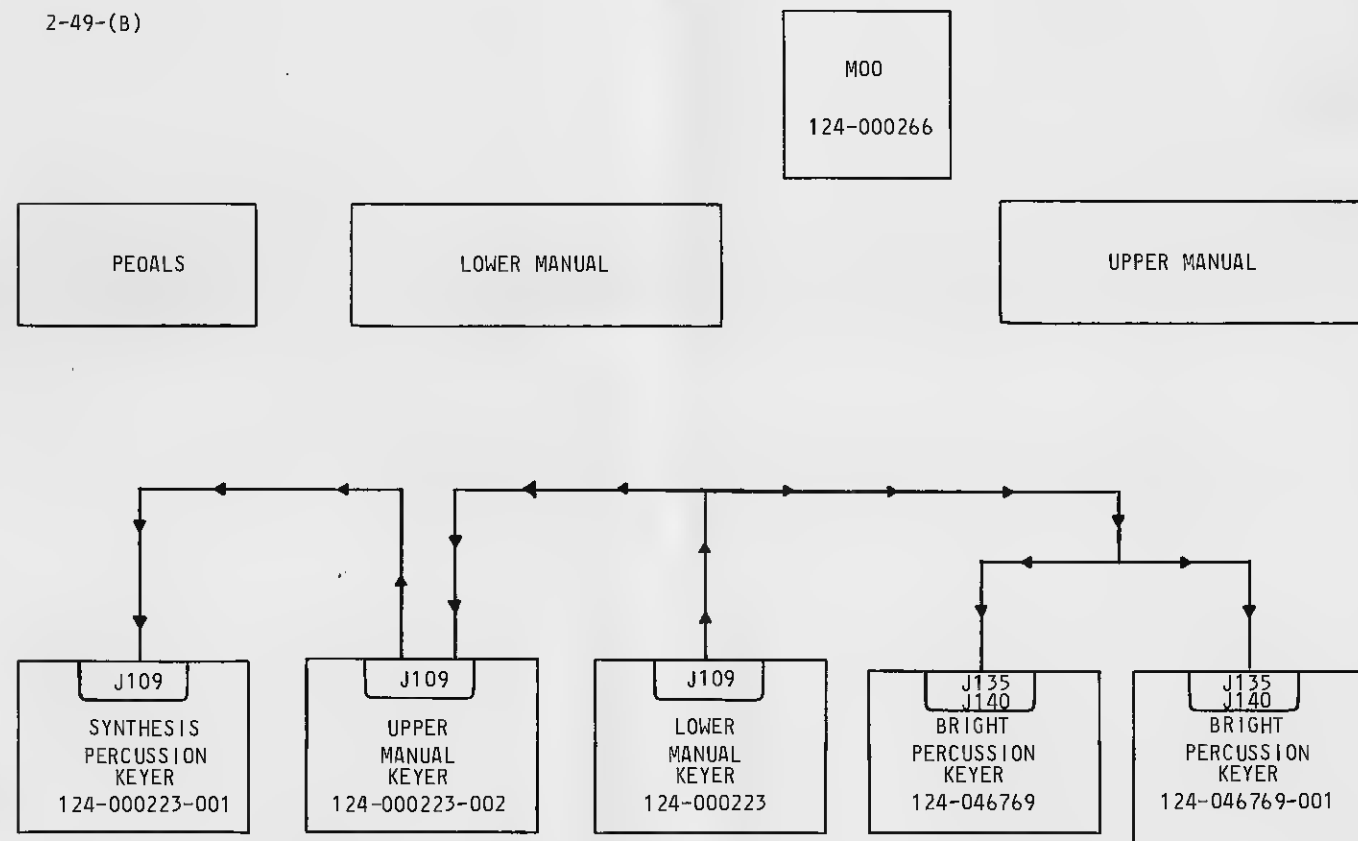
TOP OCTAVE FLOW CHART
(CLOCK FREQUENCY)

2-49-(A)



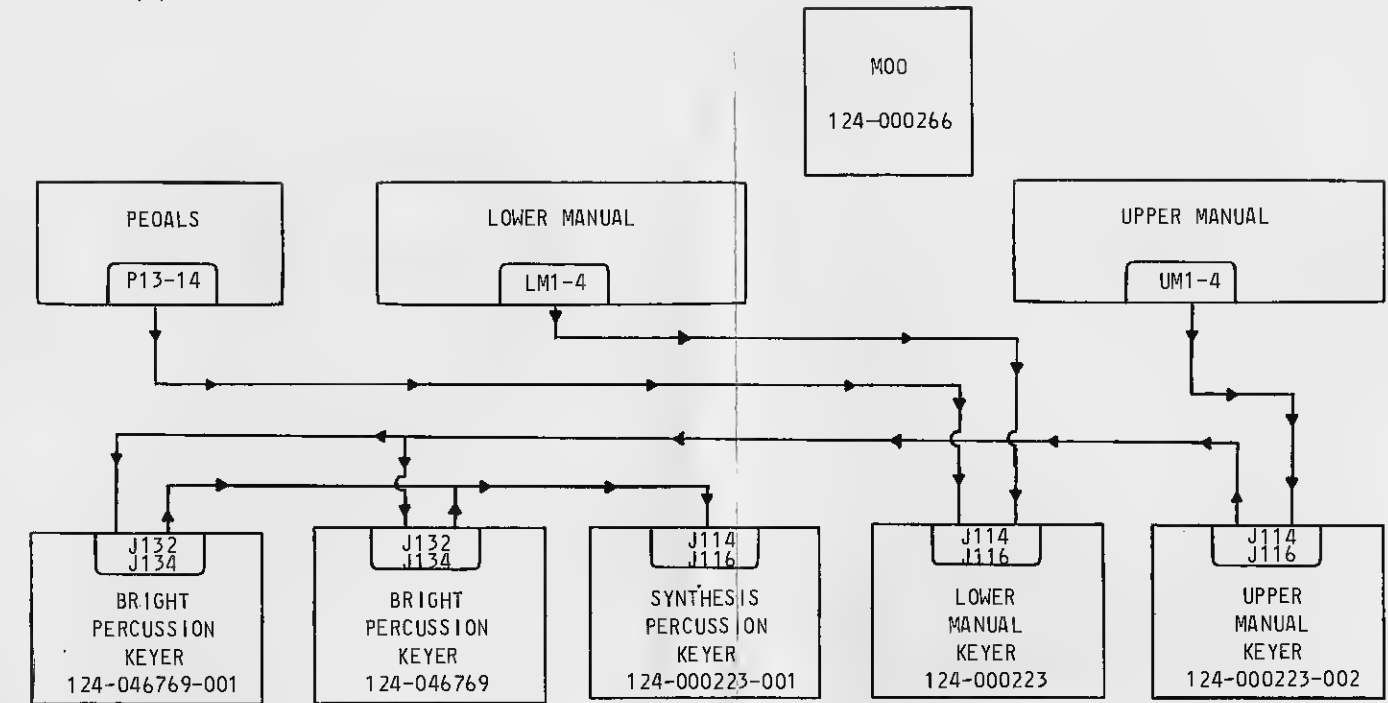
SYNC PULSE FLOW CHART

2-49-(B)



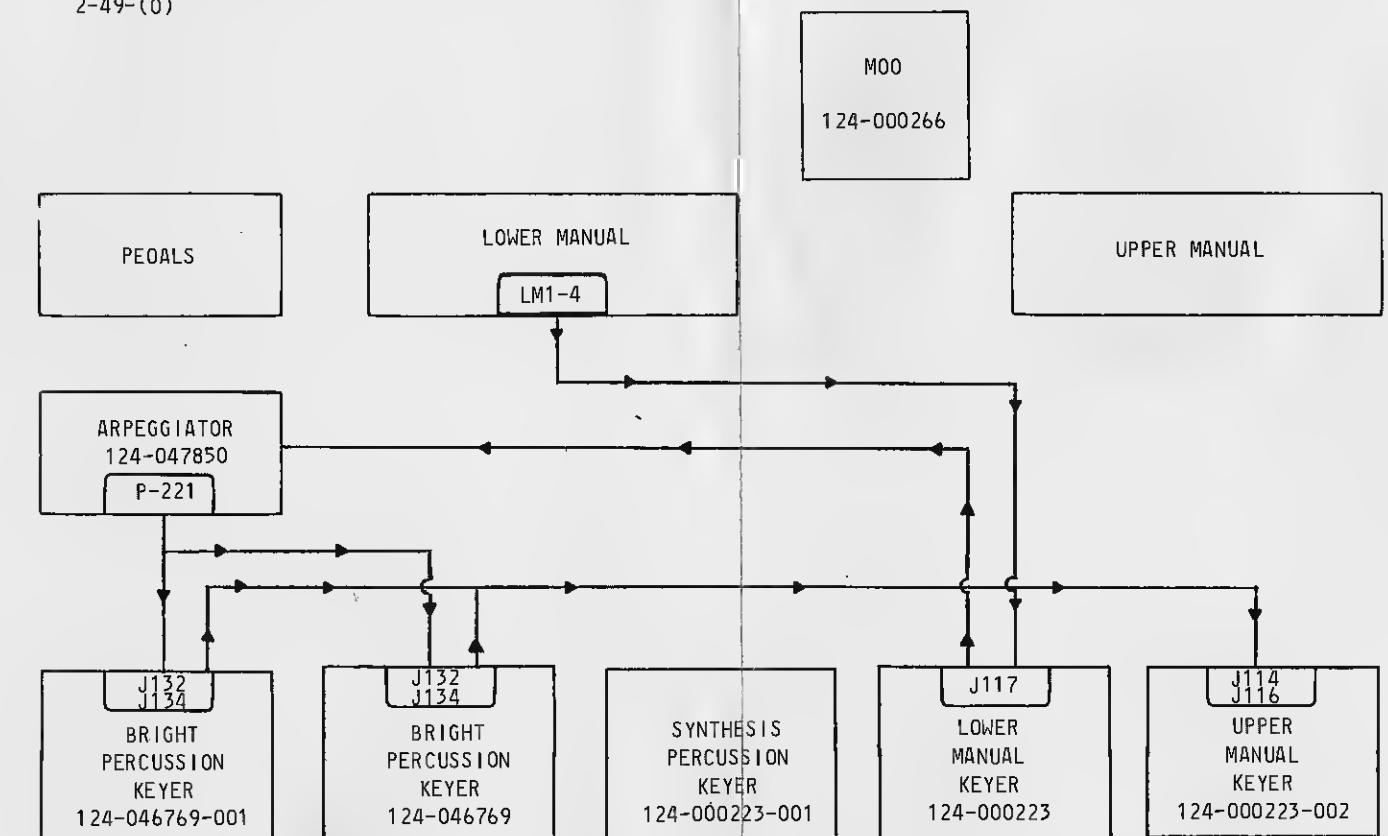
KEYING

2-49-(C)



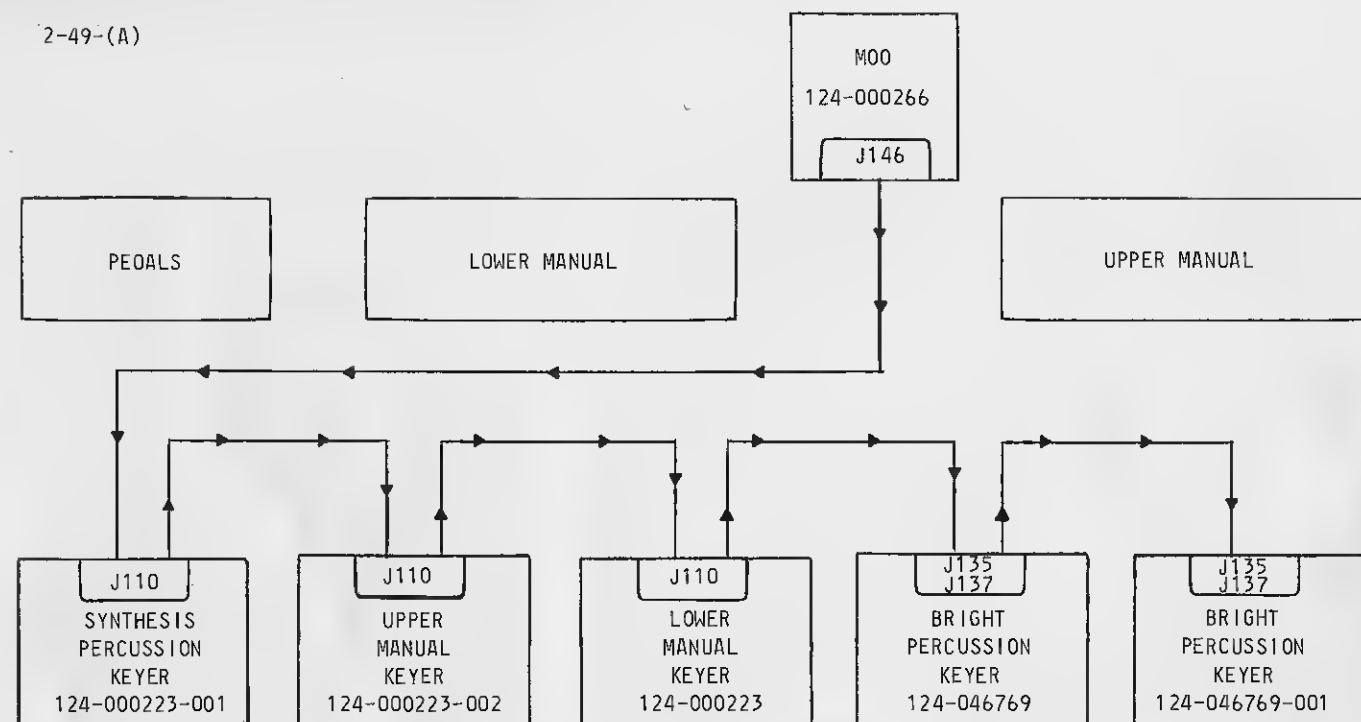
ARPEGGIATOR FLOW CHART

2-49-(D)



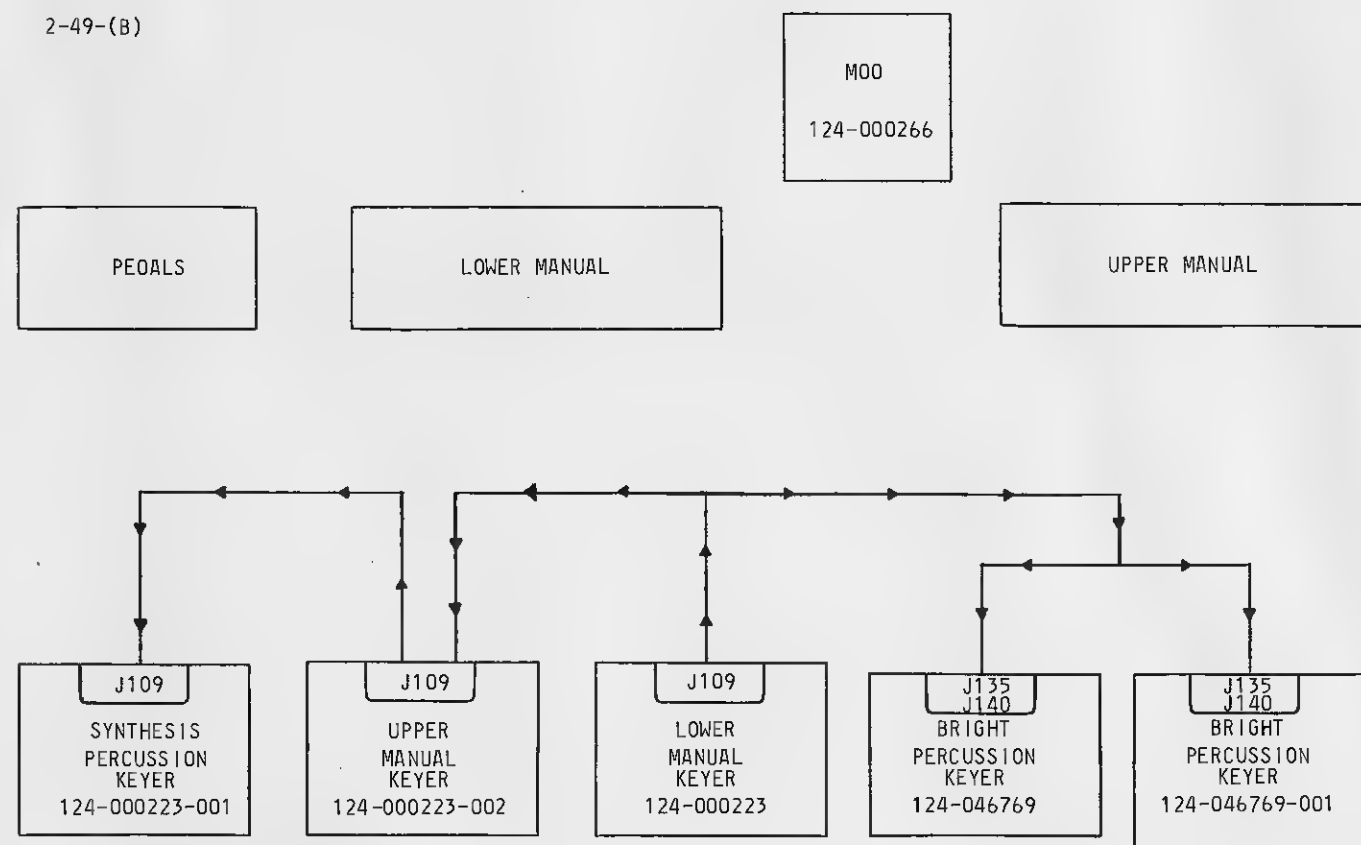
TOP OCTAVE FLOW CHART
(CLOCK FREQUENCY)

2-49-(A)



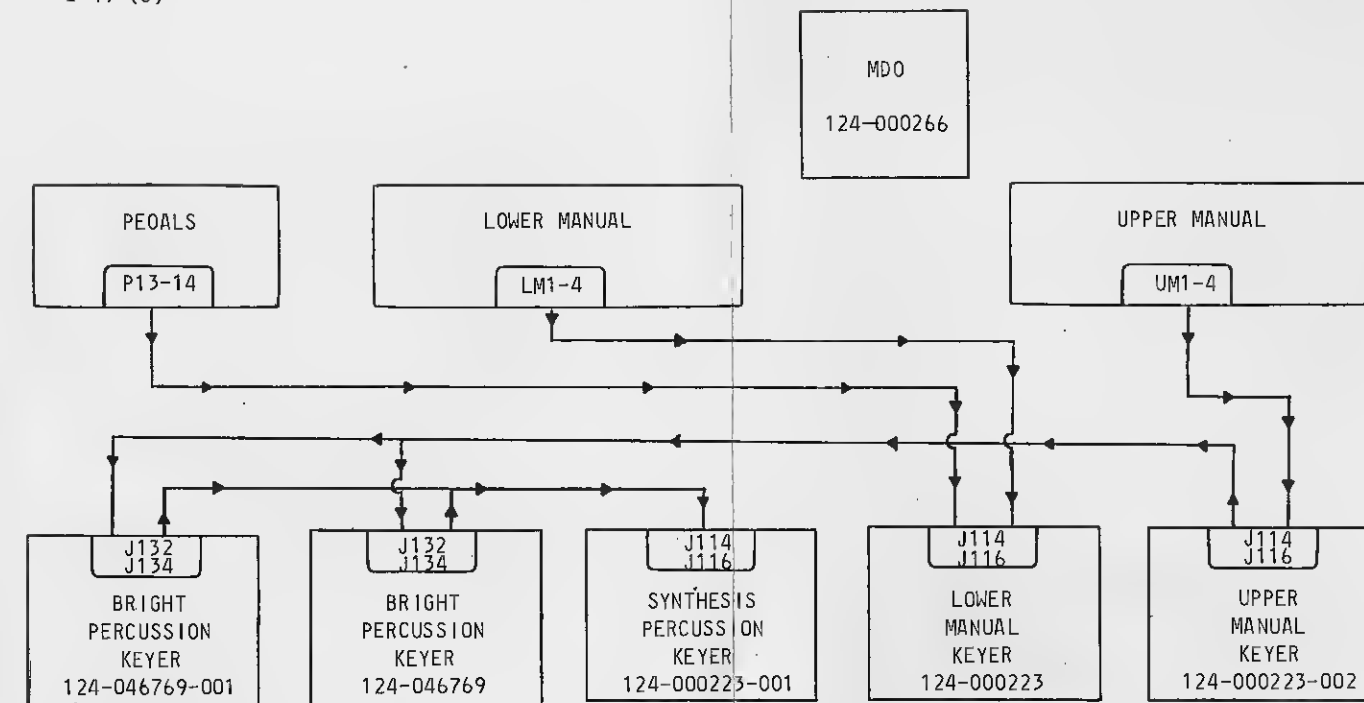
SYNC PULSE FLOW CHART

2-49-(B)



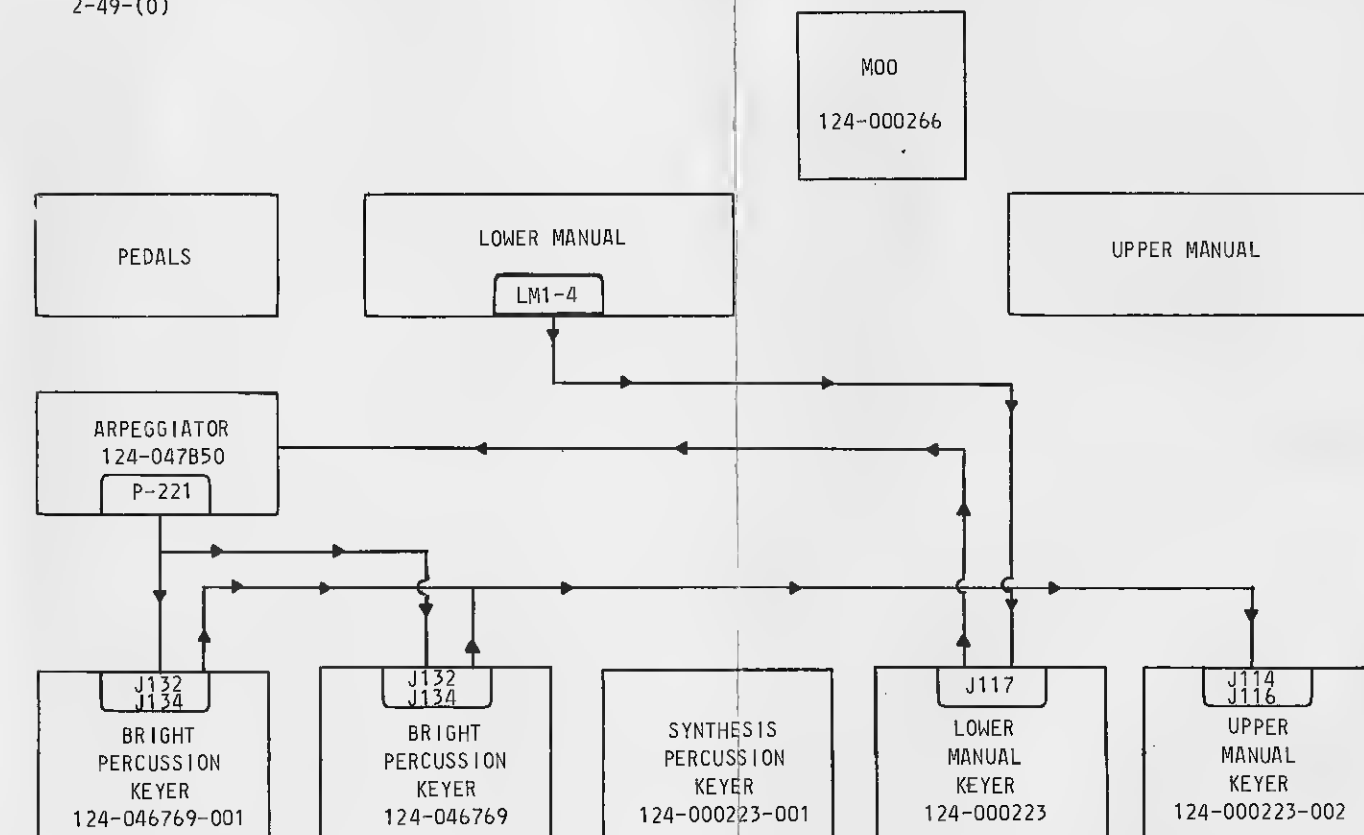
KEYING

2-49-(C)

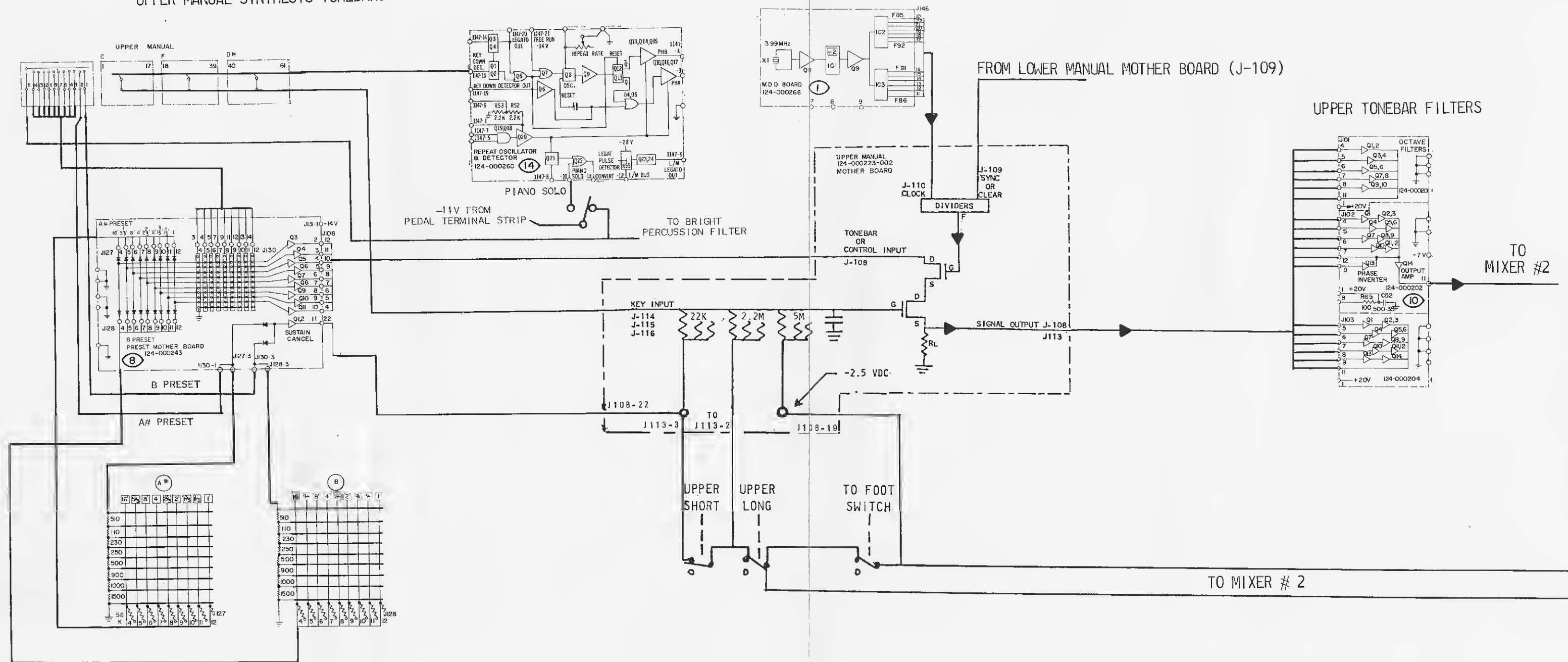


ARPEGGIATOR FLOW CHART

2-49-(D)

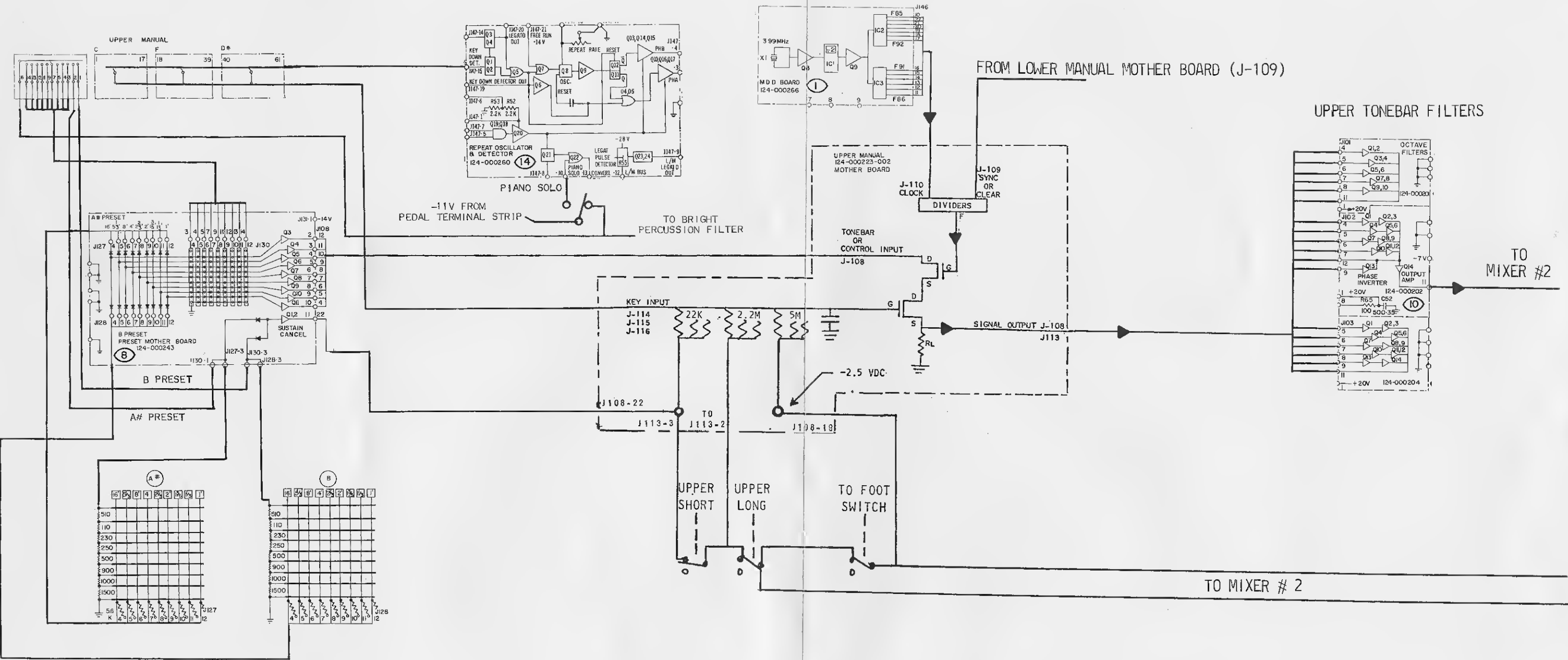


UPPER MANUAL SYNTHESIS TONEBARS



ARROWS INDICATE SIGNAL PATH

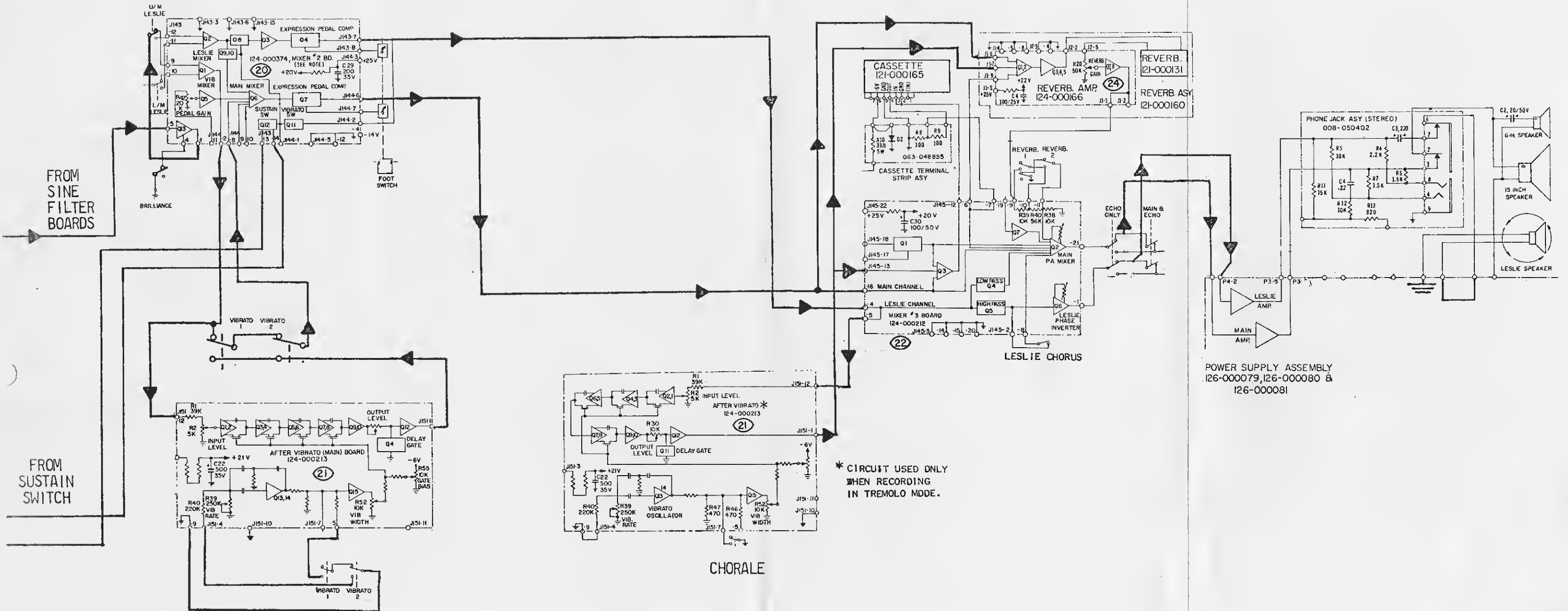
UPPER MANUAL SYNTHESIS TONEBARS



ARROWS INDICATE SIGNAL PATH

UPPER TONEBAR MIXERS

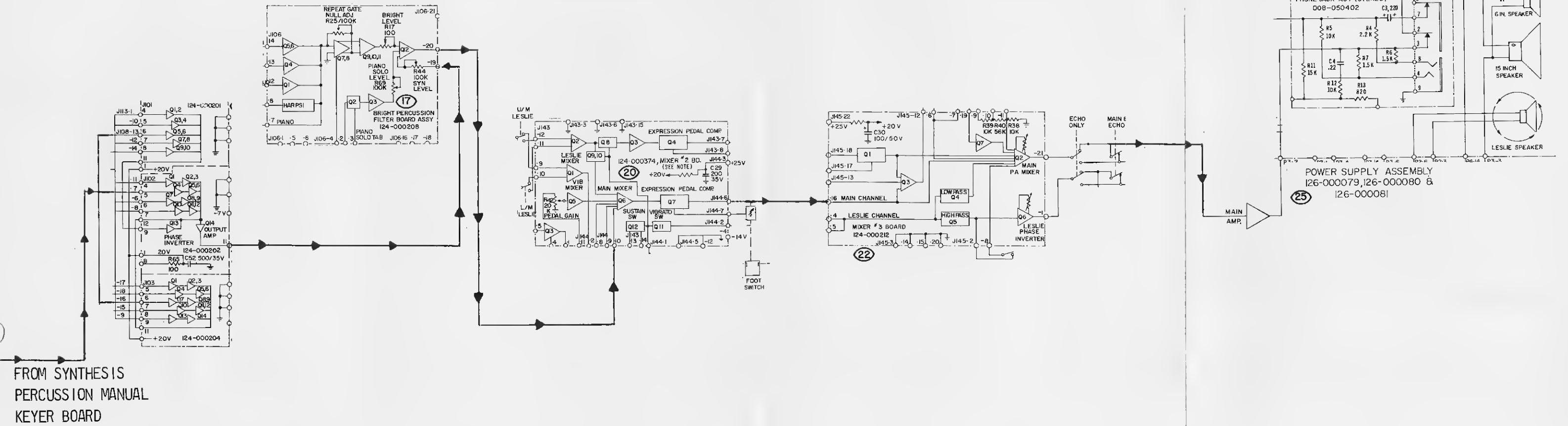
UPPER TONEBAR AMPLIFIERS

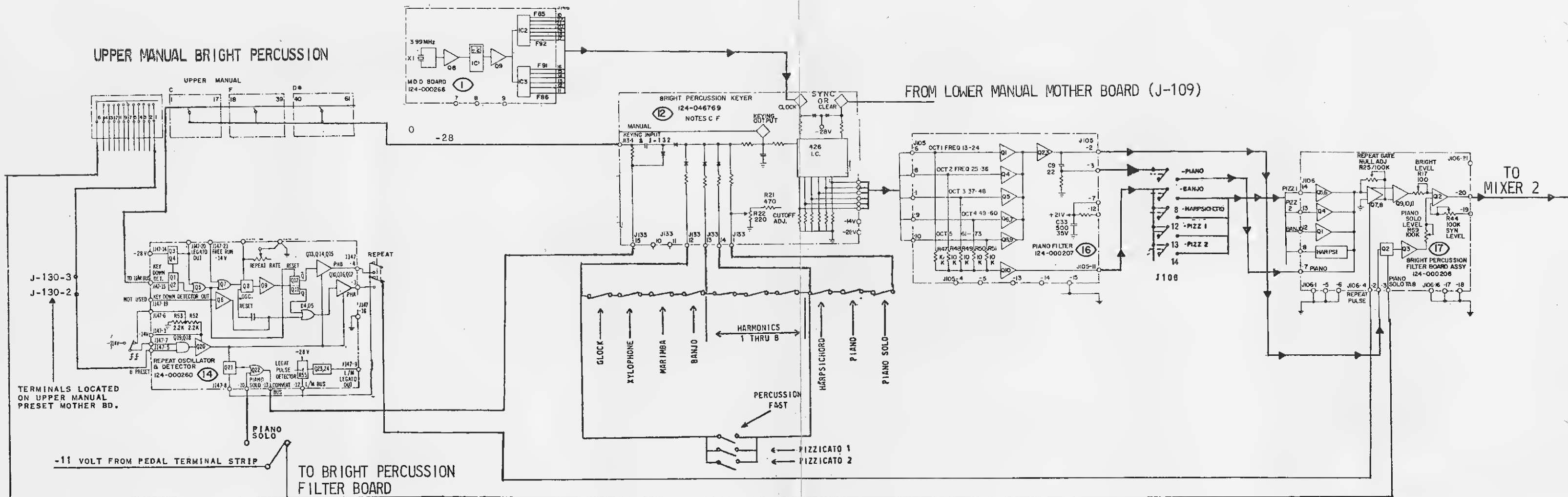


ARROWS INDICATE SIGNAL PATH

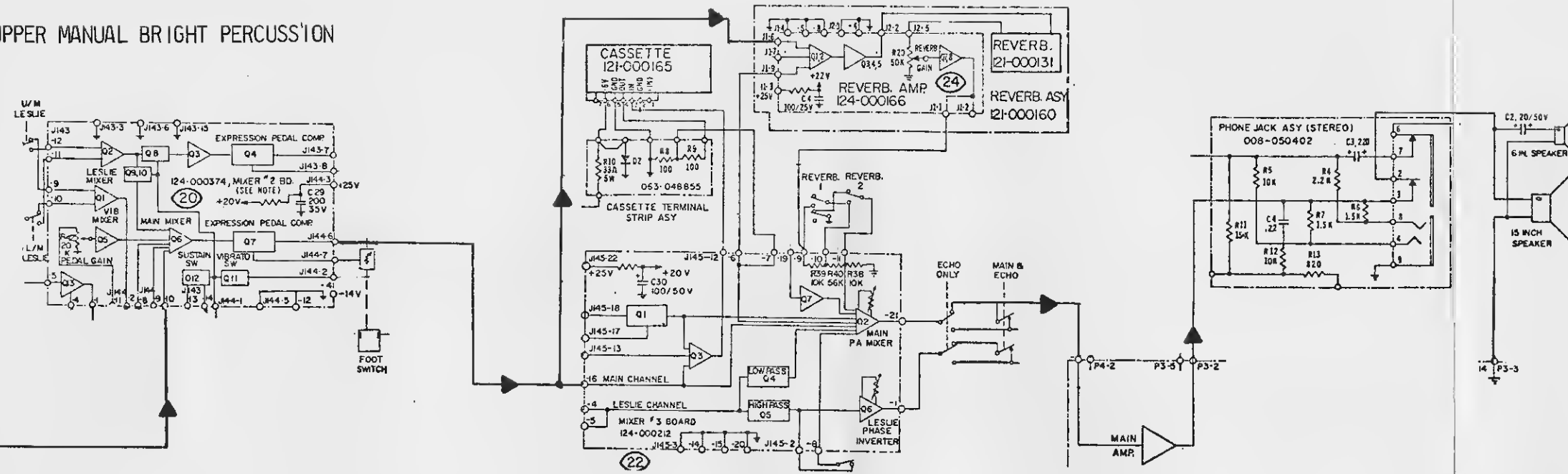
SYNTHESIS PERCUSSION MIXERS

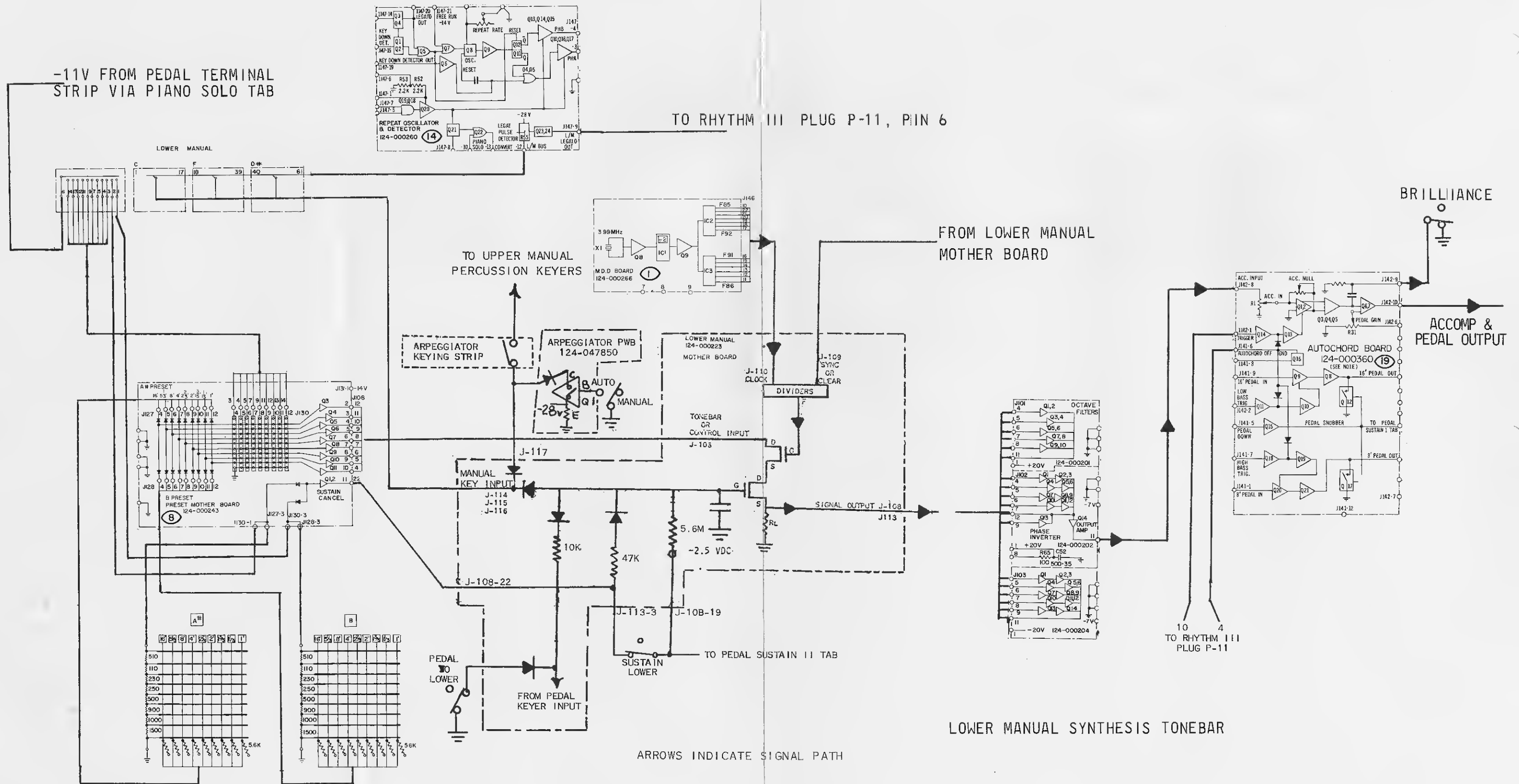
SYNTHESIS PERCUSSION AMP





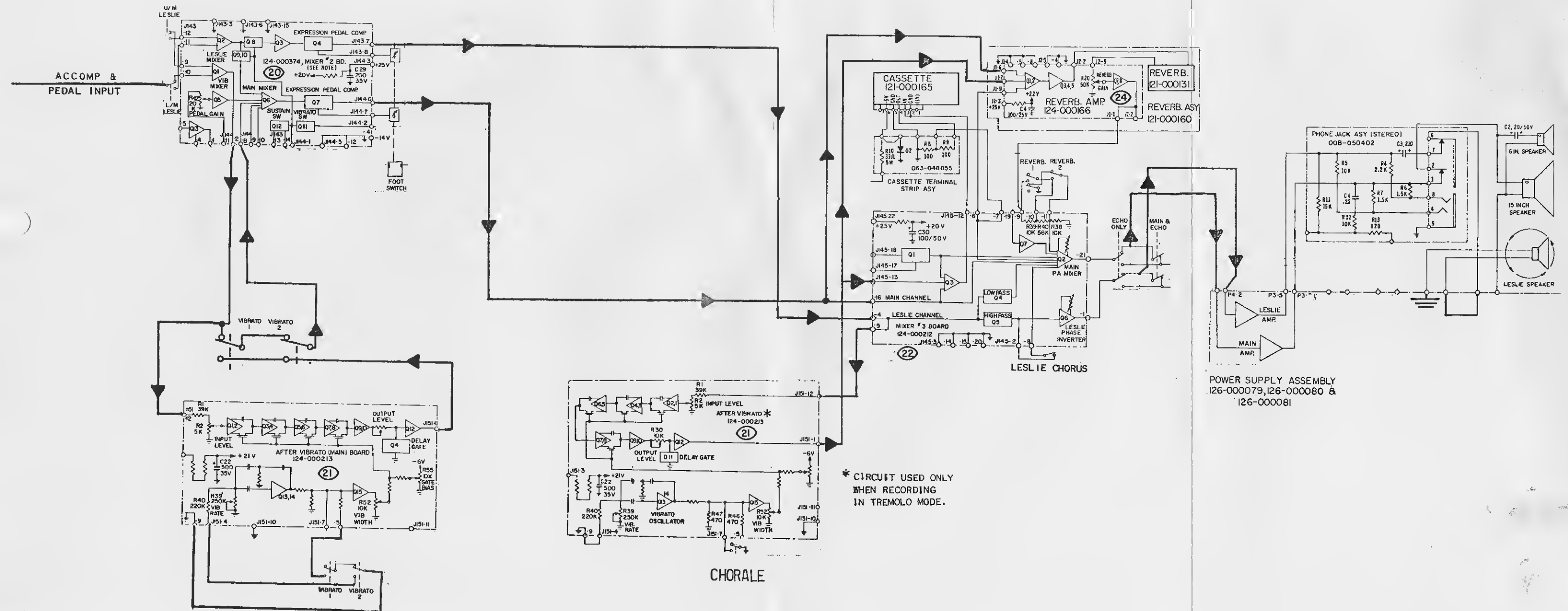
UPPER MANUAL BRIGHT PERCUSSION



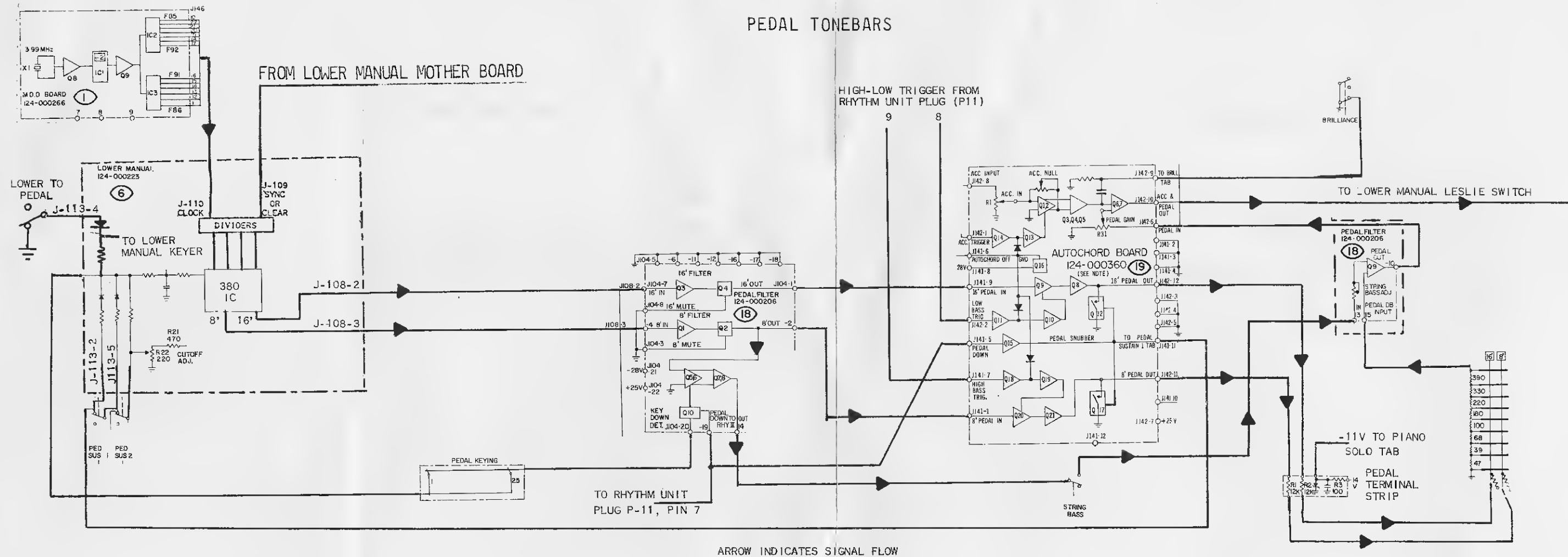


LOWER TONEBAR MIXERS

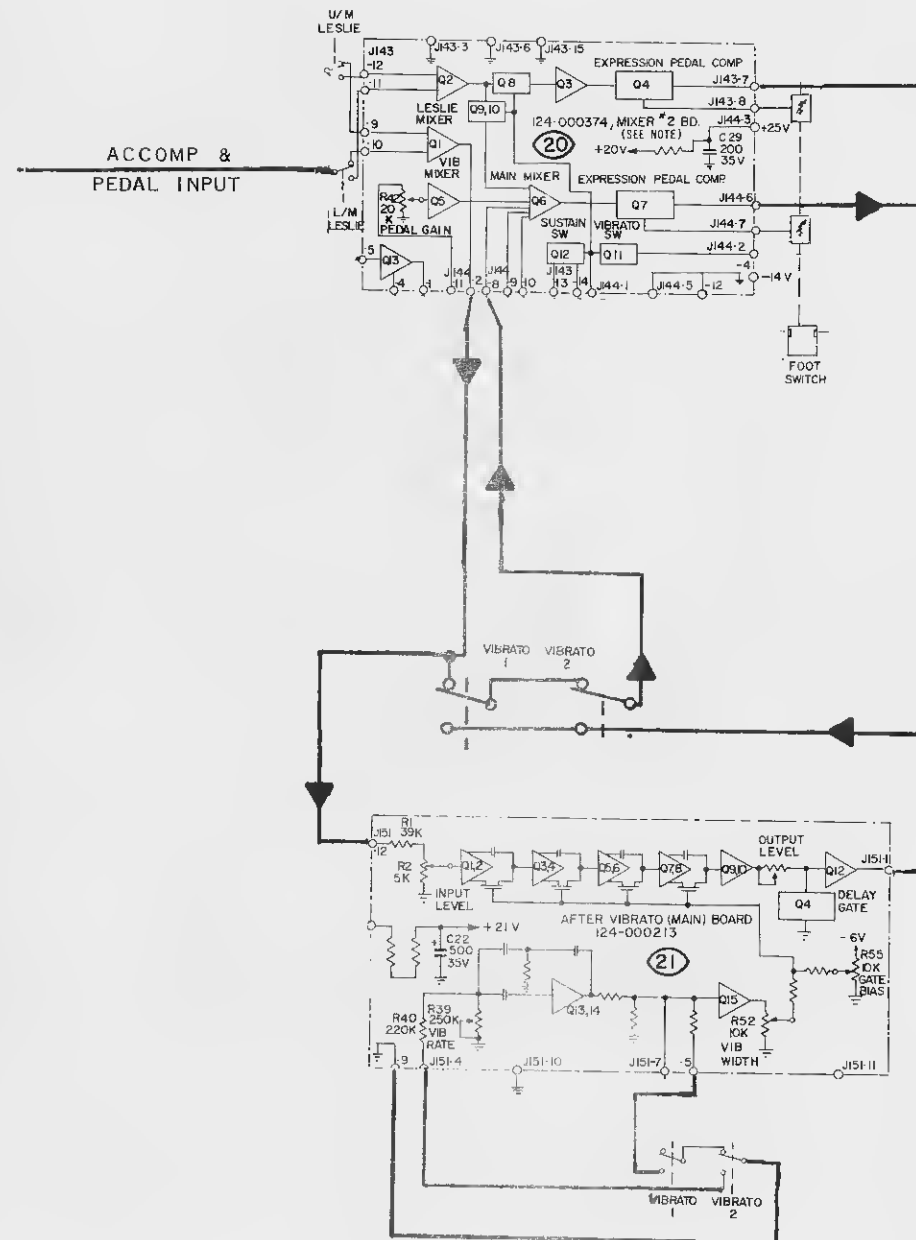
LOWER TONEBAR AMPLIFIERS



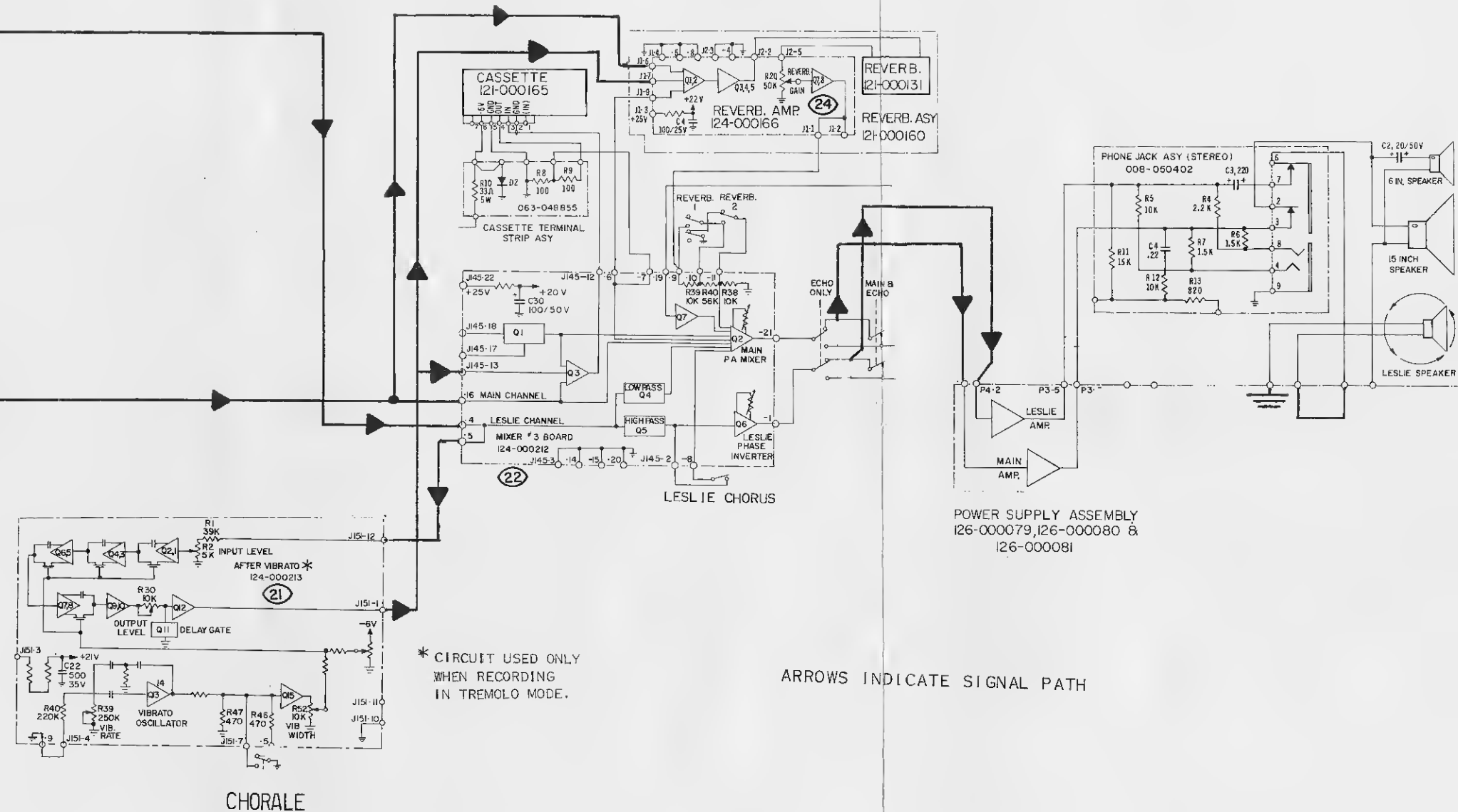
PEDAL TONEBARS



PEDAL TONEBAR MIXERS



PEDAL TONEBAR AMPLIFIERS



ARROWS INDICATE SIGNAL PATH



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2100 (CONCORDE) THEORY OF OPERATION-SHEET 1 OF 3

1. THE LSIC SYNTHESIS ORGAN

An understanding of MOSFET organ layout including basic theory and related circuit functions is a useful adjunct to service procedure. Referral to detailed schematic diagrams following the text is strongly suggested.

The Concorde is a sine-wave synthesis organ in which a square-wave audio signal from a crystal controlled master oscillator is divided many times into component signals that are subsequently shaped and combined to make musical tones. The Master Oscillator feeds a Multi-Derivative Divider system (MDD) using three LSIC packages to obtain 13 top octave frequencies (square wave) that drive four generator-keyer systems each having up to 13 sub-systems (LSIC packages) and associated circuitry.

Each package is called upon to generate all tones from subfundamentals to the highest chosen harmonic of a scale note for five octaves of playing keys. Five top octave or clock frequency inputs drive separate divider chains in each generator-keyer IC producing associated component signals. The thirteenth package handles the 61st note on console manuals (CX or extra C).

Levels of the component signals of complex tones are controlled by varying the DC supply to the keyer circuits through tonebar switches. The LSIC packages provide a single DC input for each key so that several variable level gates can be controlled at the same time. This control of individual harmonics and precise determination of their proportions in tonal mixtures makes available a tremendous variety of musical sounds. Signals are subsequently filtered to sine-wave form, mixed, subjected to envelope control, amplified and converted to acoustic waves by the speakers.

2. TONE GENERATOR

The heart of the tone generator is a crystal controlled Colpitts oscillator consisting of C16, C17, C18, R34, R35, R43, Q8, and X1. It supplies a 3-volt Peak-to-Peak square wave at a frequency of 3.99872 MHZ that drives IC1 of the Multi-Derivative Divider generator (124-000266). The -5volt supply is dropped from -14V (J146-8) by D6 and R36. C15 is used as a high frequency bypass.

IC1, the first signal divider is used to insure a square-wave input signal with a 50 per cent duty cycle to drive the MDD IC packages. Powered by the same -5V source as the oscillator, IC1 drives buffer Q9, supplying an 11 volt 1.99936 MHZ clock frequency for IC2 and IC3. Diodes D10 and D11 protect the clock input gates on the MDD package. IC2 and IC3 are the top octave frequency generators. IC3 supplies square-wave frequencies F86 through F91. IC2 produces a similar wave form at frequencies F92 through F97 and F85. Three power supplies, -11V, -16V, and 28V comes from the organ supply, -16V is provided by two diode drops, D8 and D9 from 14V through R37 to -28V. R40 and R41 form a voltage divider between ground and -14V, providing the -11V supply. (The -11 volt current and the -16 volt supply will draw from 24 ma to 70 ma). Each supply is protected from static discharge by a capacitor (C21, C22, and C23). The 16V supply is filtered by C20. All outputs of IC2 and IC3 are diode-protected from the 16V source by D12 through D24.

The clock frequencies from the MDD generator are supplied to four generator keyer systems via J110. Three are similar:

1. Poly-Synthesis Percussion
2. Lower Manual Synthesis
3. Upper Manual Synthesis

Each system has one (1) 124-000223 type mother board and up to thirteen (13) 380 LSIC's on associated plug-in daughter boards, outputs are square wave. The fourth is called Bright Wave Percussion and consists of two large Self-Contained printed wiring boards, (124-046769 and 001 having a total of six 426 IC's generating staircase signals.

4) PERCUSSION

A. GENERATORS AND KEYERS

Voices originating from either the Bright Wave Percussion Boards (124-046769 and 124-046769-001) or the Synthesis Percussion Assembly (124-000223-001 with 13 associated daughter boards, 124-000259) are available on the upper manual only. The Synthesis Percussion Assembly generates square-wave outputs for subsequent shaping into sine-waves by a filter network in a manner similar to other 380 IC systems in the instrument. However, in this case, keying outputs are supplied from an external source, the Bright Wave Percussion boards, which provide a percussion envelope as well. The keying signals enter mother board at J-114, J-115, and J-116, then go to proper daughter board, passing through an additional percussion time constant (R1, R11, C1, R6) before reaching the daughter board octave input terminals, (1 through 5). Signal outputs to sine filters are at J-113. Repeat and alternate repeat pulse enters mother board at J-108, from J-149-4 through -11 of the Synthesis Percussion Gates Board (124-000261), an assembly used for controlling negative going pulse wave-forms between the Repeat Oscillator and Detector board, (124-000260) and the Synthesis Percussion Mother Board, (124-000223-001) in repeat and alternate repeat modes. In normal keying mode, +25V is applied to the base terminals of Q9-Q18, placing them in a saturated state and shorting input to ground. When percussion tab is depressed, -14V is impressed on terminals J-148, 6, 7, 8, 9, 11, 12, 13, 14, and 15, placing Q9-Q18 in a non-conducting state, opening gates and shunting input signals through to appropriate output terminals. Phase A alone admits repeat signal only, at J-148-4. Phase A, plus phase B, adds alternate repeat signal at J-148-5, for twin mallet effect on Xylophone and Marimba voices. The Bright Wave Percussion system, consisting of the 124-046769 and 124-046769-001 boards supplies staircase signals for all "bright" voices, (Pizzicato 1, 2, Piano Solo, Harpsichord, and Banjo) plus keying outputs and percussion time constants for the Synthesis Percussion assembly (124-000223-001). IC keyers (075-000426) combine octavely related square waves in the correct proportions to produce a staircase configuration. Each 426 IC supplies outputs for all octaves and pitches for 2 notes on the upper manual. (For example: five pitches of F# and C notes on the upper manual). Dividers inside the IC, divide down the Clock (Top Octave) inputs, (J-135, J-136, J-137) to the frequencies required by the keyers. A negative DC voltage (-28V) is applied to the keyers to turn on all pitches of that note. The outputs of each pitch are combined by octave for group filtering, when necessary. To minimize interaction between keyers feeding the same filter, the input impedance of the filter is made 100 ohms or less. Consequently, the output voltage at the filter terminals (J-133-2, 3, 4, 7, 8, 9) is very low when the filters are connected. To obtain a suitable envelope, a percussion time constant circuit is connected between key inputs and the IC keyers. The capacitor in series with the input (C1 on schematic 094-045062) passes an initial spike as the key switch is closed. As the switch remains closed, R2 to R5 drain off the charge on the keyer side of C1 toward the cut-off bias set as SUS-4. If key is released immediately, C2 discharges through the same resistors, giving a short key-up tail to the note. D3 prevents discharging through the input circuit. R6 works with C1 and C2, slowing down the attack time to minimize "key click". For repeat and alternate repeat modes, percussion keyers must be converted to straight-through keying. (See Repeat, Section 4-B). This is accomplished when -28V is applied to J-133-15, allowing R1 and D2 to discharge C1 quickly. To prevent cancellation effects, the 426 IC outputs are synchronized with the other Concorde keyer-generator systems. A "master" sync signal from J-109 on the Lower Manual Synthesis Mother Board, (124-000223), enters the clear inputs of the IC's (J-135, 7, 8; J-136, 7, 8; J-137, 7, 9) causing them to act as "slaves". Keyer cut-off control R22, located on the 124-046769 board, is used to adjust the point to which the keying voltage decays during the sustain portion of the percussion mode. Thus, all Percussion Keying outputs, with the exception of those from rhythm units,

come from the Bright Wave keyers and when percussion system is activated, each note has its own percussion keyer. The decay-before-release function causes notes to die away even if keys are held down.

B. REPEAT

When repeat is used, however, keyers must convert from percussion to normal mode so that as long as keys are down, enough signal is present for the repeat keyer to turn on and off. This is achieved by the Repeat Oscillator and Detector assembly, (124-000260). When the Repeat tab is "on", no connection is made to terminal 8, therefore, Q14 and Q15 are off and terminal 13 is at about -28V. This voltage applied to convertible keyers puts them in normal mode. With the Repeat tab "off", Q14 and Q15 conduct, bringing terminal 13 near zero volts which places convertible keyers in percussion mode. Depressing the Piano tab applies -6V to terminal 10, putting the keyers in percussion mode, overriding the Repeat tab. The FF tab selects between -5V low volume and -10V high volume gating potentials. The Repeat Oscillator and Detector senses when any upper manual keys have been played and activates circuitry which produces repeat and alternate repeat percussion keying pulses. The legato pulse generator for the lower manual is also located on this assembly.

Activating the "B" preset key affects this assembly by applying -10V through R44 to the base of Q13 causing it to conduct, turning Q12 off and bringing Q11 nearer saturation, which gates a higher potential to drivers Q16 and Q19, thus providing greater signal amplitude at repeat (Pin 3) and alternate repeat (Pin 4) outputs.

Q1 and Q2 comprise the upper manual key-down detector. When no keys are played, Q1 and Q2 are biased off, terminal 15 is near -28V. If any keys are played, current applied through R1 turns on Q1 and Q2 and their collectors drop to -26.5V, firing monostable multivibrator Q3 and Q4. A negative going pulse from the collector of Q4 enters the "OR" gate at R7, R8 along with negative voltage from the collectors of Q1 and Q2 and is applied to the base of Q5, causing terminal 19 to go to -28V. The period of the monostable multivibrator is adjusted to keep terminal 19 negative during the entire time that manual keys might exhibit "bounce".

REPEAT OSCILLATOR AND KEYERS:

When no keys are being played, Q9 is conducting, keeping C5 discharged. Upon playing any keys, Q9 is biased off, and C5 starts charging through R14 and the repeat rate potentiometer. Q8 does not conduct until C5 charges to a specific voltage, then Q8 turns on and quickly discharges C5. The resulting current flow through R16 produces a pulse which is amplified by Q10 and used to trigger keying bistable multivibrator Q17 and Q18. The keying multivibrator remains in the state it is in when the last key is released. Subsequent playing of a key causes negative voltage at terminal 19 to be transmitted through D19 to the multivibrator, setting it to the state where Q17 is off with its collector at zero volts and Q18 is on with its collector at -14V. Should the multivibrator already be in this state, it will remain there. After the initial pulse via D10, each succeeding pulse from Q10 will change the state of the multivibrator.

Positive going voltage changes at the collector of Q17 are differentiated and applied to the base of Q16. The negative pulse output at the collector of Q16 charges the timing capacitor C17 through D15.

If the rest state of the multivibrator is such that the collector of Q11 is positive, no pulse is present to drive Q10 when the first key is played. To insure the availability of a drive pulse, a signal is coupled from the collector of Q3 through D17 and C20 to the base of Q16. (Q6 produces a positive pulse with the first key down). C15 starts to discharge rapidly through D14 and R33 toward a voltage level determined by voltage divider R32 and R33. As the voltage at C15 becomes more positive than the voltage set by R32 and R33, D14 cuts off and C15 continues to discharge at a much slower rate through R40. The initial rapid discharge gives uniform duration of notes at fast repeat rates and keeps notes from sounding too short at slow repeat rates.

Q22 and Q23 make up a Darlington amplifier with a high input impedance which provides a low output impedance to drive the Synthesis Percussion Gates (124-000261) circuitry in the repeat mode. The positive going output at the collector of Q18 is used in a similar manner along with Q19, Q20, and Q21 to drive the Synthesis Percussion Gates Circuitry for the alternate notes in the Xylophone and Marimba voices.

Q6 and Q7 make up a monostable multivibrator for use as lower manual legato detector. Q7 is normally conducting, holding Q6 off. When a lower manual key is played, the voltage across R55 triggers the circuit causing Q6 to generate a negative pulse at terminal 9. This action repeats for each additional key until 15 or 20 are played.

C. PIANO

The Concorde Piano voice is produced from a staircase wave input on the Piano Filter P.W.B. (124-000207). It has three filter groups fed by a five octave input with the three lowest octaves tied together and applied to a single filter section. IC keyers develop a signal of 150-200 mv P-P at the 150 ohm input load resistors. Active low pass 2 pole filter sections are used, with an extra high pass filter stage in the two highest octaves providing a sharp low frequency cut-off slope to reduce keying thump to an acceptable level. The lowest octave uses input and output coupling capacitors to control low frequency cut-off. The three filter groups are mixed into summing amplifier Q2 and passed through another active low pass 2 pole filter section, where Q3 provides a low impedance output for Piano and Piano Solo inputs on the Bright Percussion Filter Board Assembly (124-000208).

Another function of the Piano Filter Board is, supplying an output for the low impedance filters on the Bright Percussion Filter P.W.B. (Pizzicato 1, 2, Banjo, Harpsichord), the five octave staircase wave frequencies are resistively mixed into bright summing amp. Q10, (bypassing the piano filters) which provides a low impedance output at Pin 11. A resistor in series with the output supplies automatic robbing so that one voice can be loud enough without having several voices at an unreasonable level simultaneously.

NOTE: Earlier versions of the 124-000207 Board contained five filter groups for the inputs instead of three, but were similar to the current design in all other aspects.

D. MIXING

Banjo, Harpsichord and Pizzicato voices are produced on the BRIGHT PERCUSSION FILTER BOARD (124-000208) using staircase waves from Pin 11 on Piano Filter board---(124-000207). Signals enter the board at J-106 and pass through three active filters; Pizzicato 1, 2, and Banjo, a passive filter is used for Harpsichord. The filter outputs are mixed with a Piano voice input from the 124-000207 board into the repeat gate composed of Q7, Q8, Q9, and Q10, a two stage differential amplifier that has the emitter current of its first stage (Q8-Q9) supplied by a sawtooth repeat signal from J-147 on the Repeat Oscillator and Detector board (124-000260) when repeat is on, or a DC level when repeat is off. There is a null adjustment (R28) to minimize repeat thump, requiring a matched pair of transistors (001-021260-001) in the first stage to achieve the best null. Tab action changes the D.C. level at the repeat gate providing Fortissimo as desired. When Piano Solo is used, repeat signal and control voltage are removed, turning off Bright Percussion.

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B. PEDAL TONES

Pedal output signals (Square-Wave) from J111 and J112 on the Lower Manual Synthesis mother board, (124-000223) enter the 16' and 8' active low pass filter circuits at J104, pins 4 and 7 of the Pedal Filter board, (124-000206) where sine-wave pedal tones are produced. 8' string Bass gating and a pedal down detector are also provided. The String Bass gate is a two stage differential amplifier, (Q5-Q6 and Q7-Q8) which operates in a touch response percussion mode, but does not decay to inaudibility. Touch response keying information for the String Bass circuit and follow-the-player rhythm is provided by the pedal down detector, which connects to the pedal keying bus. R47 and R48 prevent Q10 in pedal down detector from failing when pedal keying bus is shorted to ground. Pedal tones go to associated terminal strip and to either J141, pins 1 and 9 on the Auto-Accompaniment board (124-000360) or to pedal tonebars through external 12K resistors, then back to Q9 on Pedal Filter board for amplification and mixing with String Bass.

CAUTION NOTE: Early models of the 124-000206 board do not have protective resistors, therefore pedal keying bus must not be shorted to ground.

C. SIGNAL DISTRIBUTION

The sine wave filter and pedal filter outputs proceed to mixer #2 (124-000374), which is used to provide animation cancel circuitry, swell pedal contouring for main and tremolo channels, mixing of upper and lower manual signals into After Vibrato or Acoustic Tremolo, and mixing of After Vibrato output, percussion, rhythm low frequencies, and pedal signals into the main channel.

A brilliance control is included for the upper manual. When brilliance control is on, a ground is removed from the circuit allowing upper manual response to be flat. Turning off the brilliance control connects circuit to ground and response rolls off 3 DB/octave from 2000 HZ. The control has a built-in 2 DB loss, which enables the lower manual brilliance control on the Auto-Accompaniment board (124-000360) to be effective.

The animation cancel circuitry is an electronic single pole, double throw switch with "pop" suppression, activated by -28V applied through the expression pedal left side switch. Closing the switch removes all signals in the tremolo channel and routes them to the main channel. In parallel with the "Sustain to Foot Switch" tab, an electronic switch opens the upper manual 380 time constant circuit, converting the keyers to long sustain mode. Another switch grounds the After Vibrato On/Off control line, removing vibrato.

NOTE: Previous Concorde models came with a 124-000211 Mixer #2 Board a device similar to the current design, but without "pop" suppression and incorporating a pedal control pot which is now on the Auto-Accompaniment (124-000360) assembly.

After this stage, the signals are routed through the expression pedal control to mixer #3 board (124-000212) which provides cassette mixing, phono preamplification, acoustic tremolo cross-over filtering, expression pedal contouring, (For rhythm white noise voices.) a chorus input, and final mixing before main and Tremolo power amplifiers. Single stage mixer preamps, (Q3 and Q7) are used for phono and cassette inputs at J-145-19 and 13. Q1 supplies contouring for Rhythm III white noise voices. (input at J-145-18) Q4 and Q5 are low and high pass filters for the tremolo channel whose input is at J-145-4. Because final tremolo signals are acoustic and cannot be recorded directly, animation of recorded signals is accomplished by routing tremolo channel through the reverb after vibrato (124-000213) via J-145-5, then back to mixer #3 via J-145-13 where it is coupled by R25, R26, and C16 to the base of amplifier Q3 and proceeds to cassette input from J-145-12. If desired, reverb must be added to recorder playback signal. R22 controls output gain of summing amplifier Q2, final mixer for the main channel, at J-145-21. The tremolo channel output is at J-145-1, and the gain of the summing amp for this channel (Q6) is regulated by R51. C34 and R55 make up a +25V decoupling filter which reduces turn-on thump. Input impedance of the phono preamp is 50 K ohms and an input of 250 mv drives the main power amp to an output of 35 watts

R. M. S.

NOTE: Decoupling filter R55-C34 is not used on earlier versions of this assembly.

6) RHYTHM

The Rhythm III assembly is virtually independent of the instrument except for power supply and auto-accompaniment functions. It has its own tone generators, voicing board, and switching facilities. The Timing Generator assembly (124-000214) performs the digital functions of the system.

A. PATTERN & TEMPO

Timing rates are geared to a relaxation oscillator controlled by a programmable unijunction transistor (PUT). The rate is controlled by varying the charging current for C1 through the control panel pot. Oscillator output drives a buffer transistor which, in turn, drives a five stage counter made up of 3 dual J-K, DTL flip-flops. Half of IC-3 provides pulses at a beat rate to the lamp (one-shot only) when stages 2 through 5 of the counter are reset by Q3 and Q6. The five stage counter normally accepts 32 pulses before restarting. When Waltz or Slow Rock rhythm patterns are called for, the output of the fourth divider is fed back to the third divider through Q6. This feedback pulse will cause the counter to restart after reaching 24. The output of the fourth divider is also used to trigger a one-shot through R21 and C34 driving the tempo lamp at a measure rate. A set, re-set bistable made up of Q8 and Q9 with resistors R64 through R71, is used for the Touch-Start circuit. Q8 provides voice gating signals for the voicing board (124-000180) and for generator gates controlled by Q7 and Q10. A positive pulse applied to the reset input (J1-2) causes Q8 to provide a ground signal that turns off voice gating circuits, (J1-3) and is inverted by Q7. A positive signal is supplied by Q7 to Q3 and Q6, who, in turn, reset stage 2 through 6 of the counter and the beat rate divider. (Pin 9 of IC3). A positive pulse to any of the three "start" inputs, (J1-1, J1-11, J1-12) causes the bistable to change state, allowing the voice gates to open, removes the reset signal from stages 2 through 6 of the counter, turns off the beat rate divider, and provides a pulse to reset stage 1 through C4. The counter outputs are decoded and differentiated by a diode/capacitor matrix to form specific pulse sequences. The matrix has 21 output tracks which are fed to the Rhythm Selector Board (124-000196).

B. RHYTHM VOICING

On the Voicing board, (124-000180) four of the eight rhythm voices are generated by RC oscillators turned on by pulse amplifiers which provides bias current for the oscillators. All oscillator outputs are mixed and fed into a low frequency pre-amp whose output is at Pin 1 of J4. The remaining voices come from a reverse biased transistor, white noise generator, (including the high frequency part of the snare drum voices), which produces random frequencies that are shaped and filtered to form appropriate voices. These voices are combined and fed into a high frequency pre-amplifier whose output is J4 Pin 2. The two pre-amp outputs connect to separate sections of a dual volume control from which they enter the main audio channel. Follow-the-player voices are another feature of the unit. Two pulse inverters act on signals from the lower manual legato mode and pedal touch mode trigger circuits.

The lower manual inverter output (J4-14) can be switched to the Brush (J4-12) or Snare Drum (J4-7) input with front panel tabs. The pedal inverter output (J4-13) is switchable to Bass Drum (J4-20) or Cymbal (J4-4) input by actuating the proper tab.

C. AUTO-ACCOMPANIMENT

The rhythm unit also supplies trigger pulses to the Auto-accompaniment board (124-000360) which provides gating for lower manual and pedal voices, when automatic accompaniment and chording is desired. The lower manual gate has a fixed time constant provided by a two stage differential amplifier with the emitter current of the first stage supplied by pulses from the rhythm unit, and turns off when supplied with a DC level. A brilliance control is provided at the output which grounds J-142-9 to roll off response 3 DB at 2000 HZ when off. In the "on" position, ground is removed, making high frequencies apparent. Gain is unity with no phase inversion and a null adjustment is provided to reduce thump. Pedal gates are single transistor keyers and pedal down audio gating is used to prevent thump when no signal is present. A pedal snubber circuit is provided to allow channelling of pedal and lower manual signals into the tremolo unit. Pedal gain is controlled by potentiometer R31.

NOTE: On early models of the Concorde, the Auto-accompaniment functions are carried out on the Mixer #1 board (124-000210), which is similar to the current assembly but has an additional differential gate and null adjustment (for the pedals) and uses diodes to kill sustain on lower manual and pedals. Pedal snubber circuit and pedal gain pot are not provided on this board.

7. SPECIAL EFFECTS

The following devices are employed to expand the musical performance of Concorde Series organs.

A. REVERB

Reverberation is an acoustic effect that naturally occurs in a large enclosed space when repeated reflections of a sound are only slightly out of phase with its source, permitting the signals to partially blend and preventing the reflection from being perceived as a separate sound or echo. Music is usually enhanced in this manner as a result of being performed in a theater or recital hall.

The Concorde reverb system simulates this effect electronically. Part of the main channel output is diverted to an amplifier then through a transducer where it is converted to mechanical vibrations, subjected to a precise delay characteristic by traversing a long spring, recovered through reverse transduction, amplified, and sent to the final mixer, arriving slightly behind the main signals that are routed to this point directly.

From the expression pedal (J144-6) the signal enters the reverb amp (124-000166) through R1 (J1-6), and is coupled through C2 to the base of Q1. Bias for Q1 is obtained through R5. From the collector of Q1, the signal is directly coupled to the base of emitter-follower Q2, which is biased through R7. From the emitter of Q2, the signal is developed across R8 and coupled by C3 and R9 to the base of Q3. Bias for Q3 is supplied through R11. From Q3's collector, the signal is coupled in half-wave position to push-pull amplifier section Q4 and Q5. The negative portion of the signal, which is prevented from reaching Q5 by forward biasing D1 and D2, is direct-coupled to the base of Q4. (NPN). The amplitude of the positive portion of the signal is sufficient to reverse bias D1 and D2, and this portion of the signal is then passed to the base of Q5 (NPN). The outputs of Q4 and Q5 are combined at the junction of R17 and R18 and coupled through C6 and J2-1 to drive the reverb unit. Negative degenerative feedback is taken from R16 and connected through R15 to the emitter of Q1. Due to the insertion loss of the reverb transducers and springs, output of the unit must be amplified. Signals enter the recovery amplifier at J2-5 and are coupled through R19, R20, and C9 to the base of Q7. Bias and feedback for Q7 are supplied through R21. The output at collector of Q7 is direct-coupled to the base of Q8. The output at the emitter of Q8 is coupled to J1-1 through C11 and R26 before passing on to the final mixer. R26 is part of a reverb level control.

B. VIBRATO

Varying the pitch of a single or complex tone at a uniform rate is an ancient practice. The first music heard was the human voice, which has a built-in vibrato. All subsequent efforts to produce pleasing sounds were more or less aimed at equalling the appealing qualities of the "original musical instrument". Consequently, some form of vibrato was employed.

Because the Concorde is equipped with a crystal-controlled, "non-vibratoable" master oscillator, and is a synthesis type organ, the vibrato circuits are introduced after tone synthesis is completed, before final mixing. Two After Vibrato printed wiring boards are used, (124-000213) one each for the main and reverb channels. The desired vibrato rate is 4.8 to 6.8 HZ.

Since both After Vibrato circuits are similar, only the operation of the main channel system will be described. These are the sub-circuits included in each After Vibrato system:

1. Vibrato rate oscillator with on, off, rate, and amplitude controls.
2. Adjustable regulated bias supply and regulated reference supply voltages.
3. Four cascaded, variable phase shift circuits.
4. Output amplifier.
5. Output time delay.

From Q1 of the vibrato mixer (on Mixer #2 Board 124-000374), signals enter a potentiometer voltage divider (J151) on the 124-000213 board. This provides a maximum level at the emitter of the first phase splitter of .035V R.M.S.

The Darlington phase splitter develops signals 180° out of phase at the collector and emitter of Q2. The signals are combined in the network of the collector capacitor, C3 and the FET, a section of IC1 which is used as a variable resistor. The source-to-drain resistance of the FET is controlled by a DC voltage appearing between the source and gate terminals. When the gate is slightly negative to the source, the drain-to-source resistance is low (100-600 ohms). As the gate is made more negative to the source, the drain-to-source resistance rapidly increases to many megohms. This high resistance is limited to 24K ohms by R6 and R7 in series across source and drain of the FET. By applying DC bias to the gate and superimposing a vibrato rate sine-wave on the bias, the source-to-drain path appears as a pure resistance, varying at a predetermined rate from 100 to 24K ohms, in a sine-wave configuration. Feedback at the FET gate is supplied from the junction of R6 and R7 through C4 to cancel phase distortion of the FET. The signal at the junction of C3 and the drain of the FET varies in phase due to the reactance of the capacitor in conjunction with the varying resistance of the FET.

How phase shift occurs: Assuming the two extremes of FET resistance to be zero ohms and infinity, at the zero point the collector signal is attenuated by the reactance of capacitor C3, so the signal appearing at the junction of C3 and the FET has the phase of the emitter signal. When the FET goes to open circuit or infinite resistance, the C3-FET junction is connected only to the collector signal, phased 180° away from the emitter signal. Since reactance is a function of frequency, a frequency occurs where capacitor C3 reactance equals FET resistance. At this point, the phase appearing at the C3-FET junction is 90° away from both collector and emitter. As the FET resistance varies smoothly between its limits, the phase of signals appearing at the junction varies smoothly between the limits determined by capacitor reactance and signal frequency. Since an instantaneous change in phase is equivalent to a change in frequency, a vibrato effect is obtained when phase is changed at vibrato rate in a sine-wave manner. A single stage does not provide sufficient phase shift for the required vibrato effect, so four stages have been cascaded. The fourth stage is amplified to provide standard level (1V) and impedance. The single transistor joining the base of the final output transistor to ground is a delay switch to hold output cutoff until circuit voltages have stabilized after power is applied.

On-Off gating at Q2 and amplification at Q3 are provided for Piano Solo whose input at Pin 2 bypasses the repeat gate. Synthesis percussion signals enter this board at Pin 19 and are summed with repeated bright percussion and Piano Solo at output amplifier Q12. Gain controls are provided for these signals at R69 (Solo), R44 (Synthesis), and R17 (Bright). The required +21V comes from the Piano Filter board (124-000207) which has a decoupling filter for the supply.

NOTE: Earlier versions of the 124-000208 Bright Percussion board have matched 001-021270's in the repeat gate, (Q7 and Q8).

5) VOICING

The characteristic sound of the organ voice is obtained by mixing sine-wave signals produced in a variety of filter sets.

A. MAIN FILTER SYSTEM

Square-wave outputs from the upper and lower manual synthesis and percussion 380 mother boards go to separate sets of sine-wave filter boards, (three filter P.W.B.'s for each mother board, 124-000201, 202, and 204) where they are used to produce sine-wave tones. There are 14 filter groups in each set to match the 14 signal output terminals of a typical 380 assembly. Each group passes one 12 interval octave plus one note, with the exception of group #1, which is for frequencies #1 through #12 only. Pass bands of the filter groups overlap by necessity due to the combination of pitches on the 380 outputs. A total range of 8 octaves is available. (Frequencies #1 through #97).

On the first five groups, a 150 ohm resistor is used at the input to develop the square-wave output current from the 380 keyers into a signal of approximately 80 mv peak to peak for one note at tonebar position 8. On all remaining groups the keyer current is summed in a bus amplifier input of very low impedance (10 ohms). The output current at the collector of this stage is the same amplitude as is developed across the 150 ohm resistors on the first five groups. The bus amp is used to prevent IM distortion from interaction between the IC keyers. It is not needed on the lower frequency groups because the IM difference frequencies are mostly sub-audible.

Most of the filter groups are two stage, 8 pole, active band-pass filters. The first stage has a pronounced peak near the top of the pass band. The second stage starts the roll-off just above the low end of the pass band, a combination which provides a reasonably flat pass band with a sharp attenuation curve. Input and output coupling capacitors are used to reduce keying thumps by providing low frequency roll-off. Filter group #1 has one RC section deleted as the sine-wave purity requirements are not as severe at low frequencies.

Filter group #14 has only one stage since the harmonics are at the upper limit of hearing. All signals from the 124-000201 and 124-000204 boards go to the 124-000202 board where Q13, a phase inverter, sums the outputs of groups one through five which do not have bus amplifiers. The remaining signals along with those from the phase inverter feed into Q14, and output amp on the 124-000202 board. Mixing resistors in the output of each filter group are selected to provide the necessary tapering. (Higher output at lower frequencies). TVI suppression capacitors are provided and isolating resistors are used to prevent failure of the output amp or the phase inverter.

NOTE: Earlier versions of these boards do not have TVI suppression capacitors or isolation resistors.

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C. ARPEGGIATOR

An electronic system for producing an arpeggio, glissando, or whole tone scale as desired, by stroking a miniature keyboard under a mylar strip located between the manuals. This device is connected to the Arpeggiator Board (124-047850). Next to the strip is a switch that selects between MANUAL and AUTOMATIC modes. In the MANUAL mode, ground is disconnected from Q1 and Q2, through R2 and R3. The keys depressed on the lower manual determine which notes registered on the upper manual will be heard, including those in octave relation thereto. If no lower manual keys are activated, the Arpeggiator strip is dead. Twelve circuits are used, one for each note of the scale. Diodes D24 through D32 activate the "C" buss whenever a "C" note is keyed on the lower manual, while providing isolation between the lower manual keyers.

Similarly, the "C#", "D", "D#", etc., busses will activate when these notes are played. Keying a buss will apply voltage on all octaves of that note on the Arpeggiator switches. Now if the Arpeggiator is stroked, all octaves of the notes held on the lower manual will sound in succession as if they had been played on the upper manual, due to the connection of the Arpeggiator switches to the upper manual keyers.

Operating in AUTOMATIC mode, Q1 and Q2 are normally turned on by grounding their bases through R2 and R3, supplying -18V to all keying busses from the emitters through the collectors and diodes D1 through D6 and D15 through D20. (When no keys are depressed on the lower manual) This activates all busses at slightly less than full keying voltage. When the Arpeggiator strip is stroked, all notes play in succession (GLISSANDO). If notes in the same whole tone scale are depressed, -28V will be applied to the base of the associated transistor, turning it off and removing the -18V from the busses for the other whole tone scale. Only the proper whole tone scale, in tune with notes depressed, will play. If a chord is keyed on the lower manual that has notes in both whole tone scales, busses are activated with -28V on left and right sides, reverse biasing both transistors so only the busses for the notes depressed on the lower manual are activated. Consequently, only corresponding notes on the Arpeggiator become playable. Therefore, when the miniature keyboard is stroked, a glissando occurs if no lower manual keys are depressed, and an arpeggio is heard if one or more keys are held, but always in harmony with those keys. Signals from the Arpeggiator Board (124-047850) enter the Lower Manual Synthesis Board (124-000223) at J-117.

D. TREMOLO

By applying a portion of the main channel signals to a separate power output circuit, and driving a mechanically rotating speaker with it, the Tremolo system adds varying pitch and amplitude to the total organ sound. This signal comes from the main mixer, (Mixer #2 Board, 124-000374) via the expression pedal at J143-7, enters the final mixer (Mixer #3 Board, 124-000212) at terminal 4, goes to Q5, through a high pass filter, then is applied to Q6 and associated phase inverter and thereafter, to the Tremolo power amplifier.

8. AMPLIFIER AND POWER SUPPLY

A. AUDIO OUTPUT

Two 35 watt power amplifier building block modules, (124-000169), are incorporated into the Concorde power supply assembly. (126-000108-001 through 003). One module is for the main channel output and the other provides Tremolo power output. The circuits are identical and function like this: The input stage uses a differential amplifier, keeping the output at DC ground by compensating the bias of the output transistors. Eliminating bias problems makes quasi-complementary output practical. Q1 and Q2 are biased equally to ground with R3 and R5. Because the load is connected to the base of Q2 through R5, the load is at ground potential. The DC feedback path from the load to Q2 is a convenient way to apply AC feedback which is controlled by R8 and R5 whose ratio determines overall gain.

High open loop gain, permitting a large amount of negative feedback is due to Q3 operating with its emitter at AC ground (Class A). This transistor must stand the total voltage across the amplifier. D1, D2 and D3 are part of the load seen by Q3 and bias the output transistors. To bias Q6 and Q7 on the voltage drops across D1, D2 and D3 must equal the voltage drops across the emitters of Q4, Q5, and Q7, plus the drops across D8, R16, and R17. The current through the three series diodes is determined by R9 and R10, and this current determines the voltage drop across the diodes. To prevent crossover distortion, a Q6, Q7 quiescent current of around 40 ma. is necessary. Q5 and Q7 are NPN Darlington connected while Q4 and Q6 act like a PNP Darlington connection. R15 and D8 cause the overall transconductance of Q4 and Q6 to equal or nearly equal Q5 and Q7, improving output linearity. A bootstrap capacitor (C7) is connected between R9 and R10, enabling Q6 to be driven into saturation. Without the positive feedback path through Q7, drive to Q6 is insufficient for symmetrical output, an RC pad across the load (R18, C10) provides high frequency stabilization. Short circuit protection occurs during the positive cycle when series connected diodes D1 through D6 in parallel with Q4 and Q5 emitters and R17, shunt the drive to Q7 and clamp its collector current at a level just above the normal peak load current. The collector current of Q6 is clamped during the negative cycle just like Q7 with diodes D5 and D3.

B. POWER SUPPLY

A lighting transformer, tremolo relay, noise suppressing circuitry for tremolo, and four (4) fused, regulated and short-circuit protected power supply circuits (+25V, -14V, -28V, -8V) are the other items located on assembly 126-000108-001 through 003. The supply circuits used are quite conventional such as diode bridges with the usual filters. Protection and regulating circuits are worthy of mention however, and an example is herewith described: On the power supply regulator P.W.B. (124-000209), Zeners D6, D8, D16 and D17 supply reference voltage, potentiometers R7, R17, R27, and R37 are voltage adjustment controls for setting the base voltage of power transistors Q1, Q11, Q21, and Q31 thus setting output (emitter) voltage.

When the output load increases, the base voltage drops on regulating transistors, Q3, Q13, Q23, and Q33 allowing their collector voltage to become more negative bringing the bases of the power transistors closer to saturation and restoring output (emitter) voltage. If a short or similar condition is present, emitters of protection transistors Q2, Q12, Q22 and Q32 are grounded or brought near ground which in turn grounds the base terminals of the power transistors, turning off supply. Base resistors and diodes set the point at which protection transistors turn off.

SECTION III
DIAGRAMS AND TEXT

3-1. GENERAL.— This section contains schematic diagrams and text to illustrate and provide information necessary to proper organ servicing.

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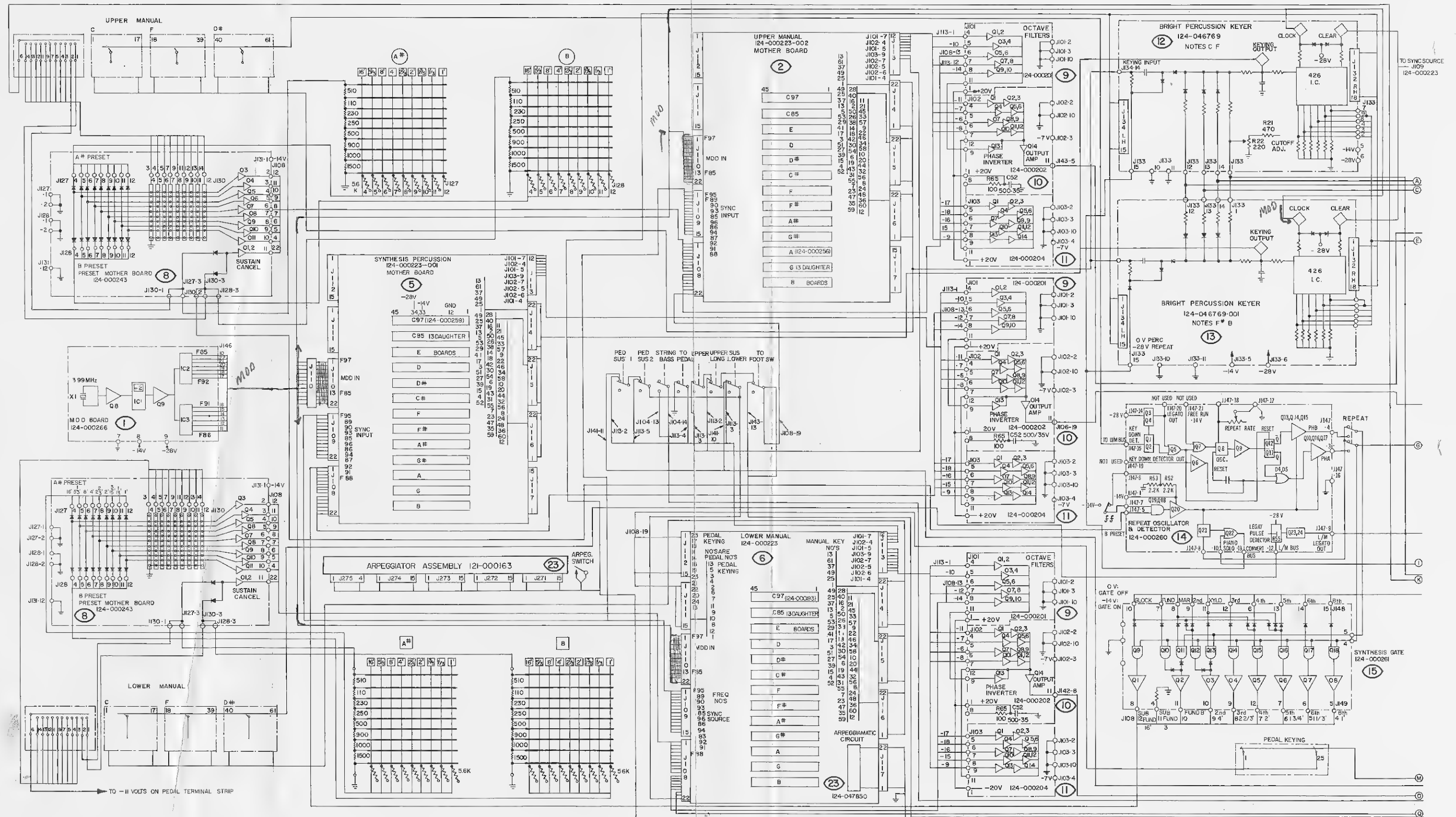
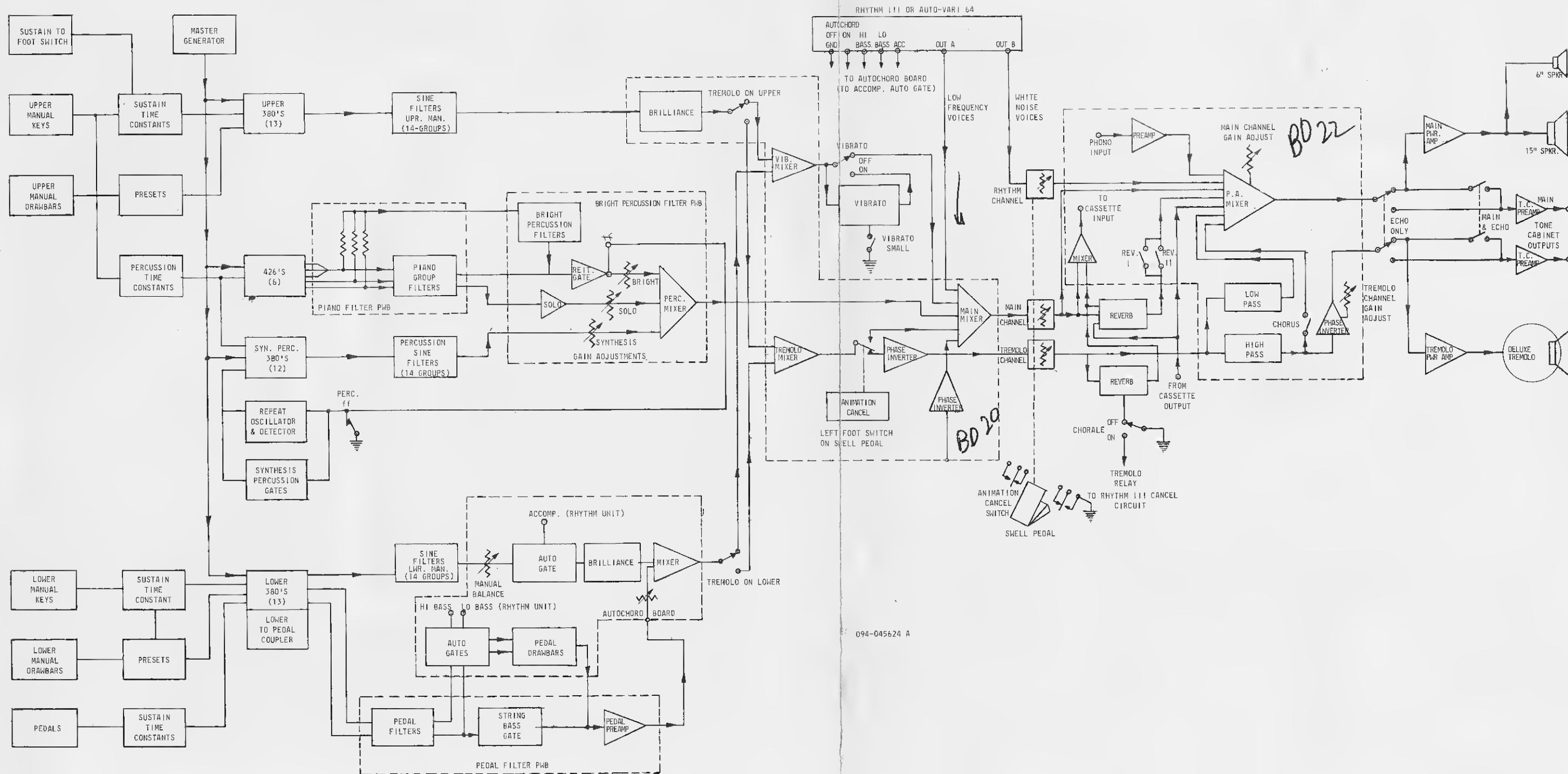
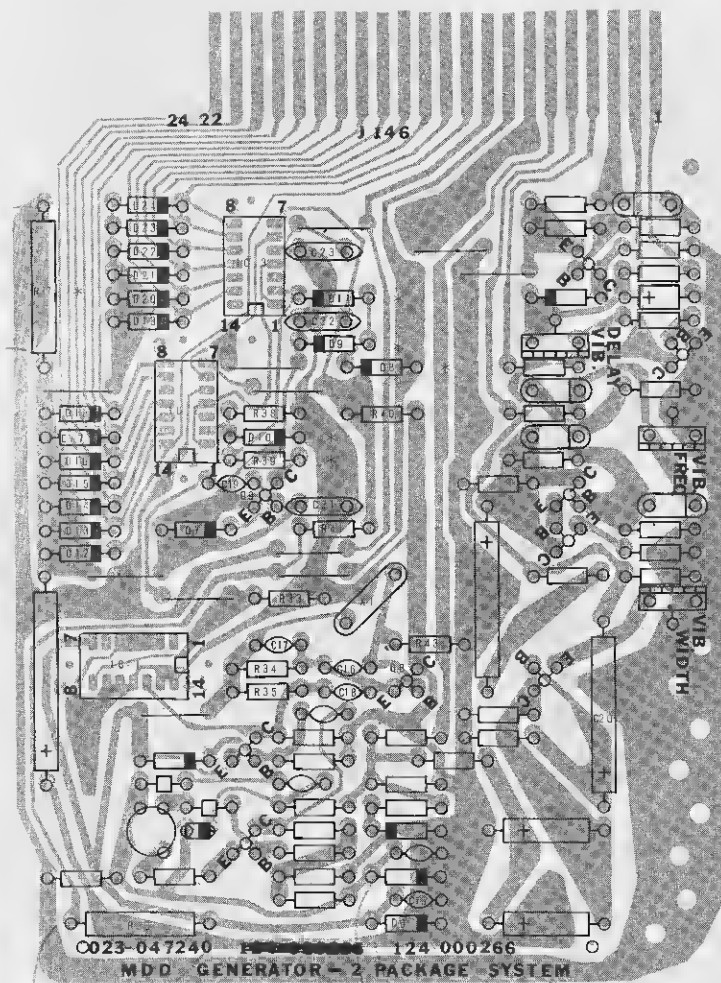


FIGURE 3-1
2100 SERIES CONSOLE
LOGIC DIAGRAM
(SHEET 1 OF 2)



094-045624 A

FIGURE 3-3
2100 SERIES SYSTEMS
BLOCK DIAGRAM



MDD GENERATOR-TWO PACKAGE SYSTEM VIBRATOABLE

Drawing 094-047241 is the schematic diagram for assembly 124-000265 (MDD with vibratoable LC oscillator) and for assembly 124-000266 (MDD with crystal oscillator). As indicated on the drawing, there are two "boxed-in" areas; one to be used for 124-000265 and the other for 124-000266; parts not in the boxed areas are common to both assemblies. In addition, a third assembly, 124-000318, is shown.

LC Oscillator With Vibrato

Assembly 124-000265 includes a vibrato oscillator, delayed vibrato circuitry, portamento capability (Auto-Glide), and a high frequency LC oscillator used to drive the MDD generator.

The vibrato oscillator is a phase shift type, comprised of C3, C4, C5, R9, R10, R11, R12, R13, R14, Q3 and Q4. Pot R10 is used to adjust the oscillator's frequency (6.8 HZ. nominal for fast vibrato); and R8 is externally connected to -28 volts for fast vibrato (disconnected for slow vibrato). The vibrato signal is coupled through C6, R15, and C7 to the base of transistor Q5, where it is amplified (its width being controlled by R20).

Vibrato may be turned off by connecting J146-2 to -28 volts, and may be reduced for "Vibrato Small" by connecting R16 through Pin J146-4 to -28 volts. To achieve a better sine wave the vibrato signal is filtered by C8 and is then coupled to the LC oscillator circuitry by C9 and R42. Delayed vibrato is accomplished by transistors Q1 and Q2. A -28 volt DC signal is applied to C1, which turns on Q1 for about 20 milliseconds; this charges C2 through D1 to a ground potential, turning on Q2 for approximately one second (until C2 discharges). When Q2 is turned on, the collector "shorts" the vibrato signal to -28 volts, thus the delayed vibrato time is approximately one second. Adjustment of R6 decreases or increases the time of the delayed vibrato. If the delayed vibrato signal is applied to C1 while J146-1 is connected to -28 volts, the vibrato delay time is decreased by 90 per cent.

The LC oscillator is comprised of L1, D3, C10, C11, C12, R27, R28, R29, and Q6, and is a Hartley type. D3, a varicap diode, is used to vary the oscillator's frequency for vibrato and portamento effects; as the voltage at the junction of R24, C10, and D3 becomes more negative, the capacitance of the varicap diode increases, and the oscillator frequency decreases. Since the cathode of the varicap is normally (with no vibrato) at ground

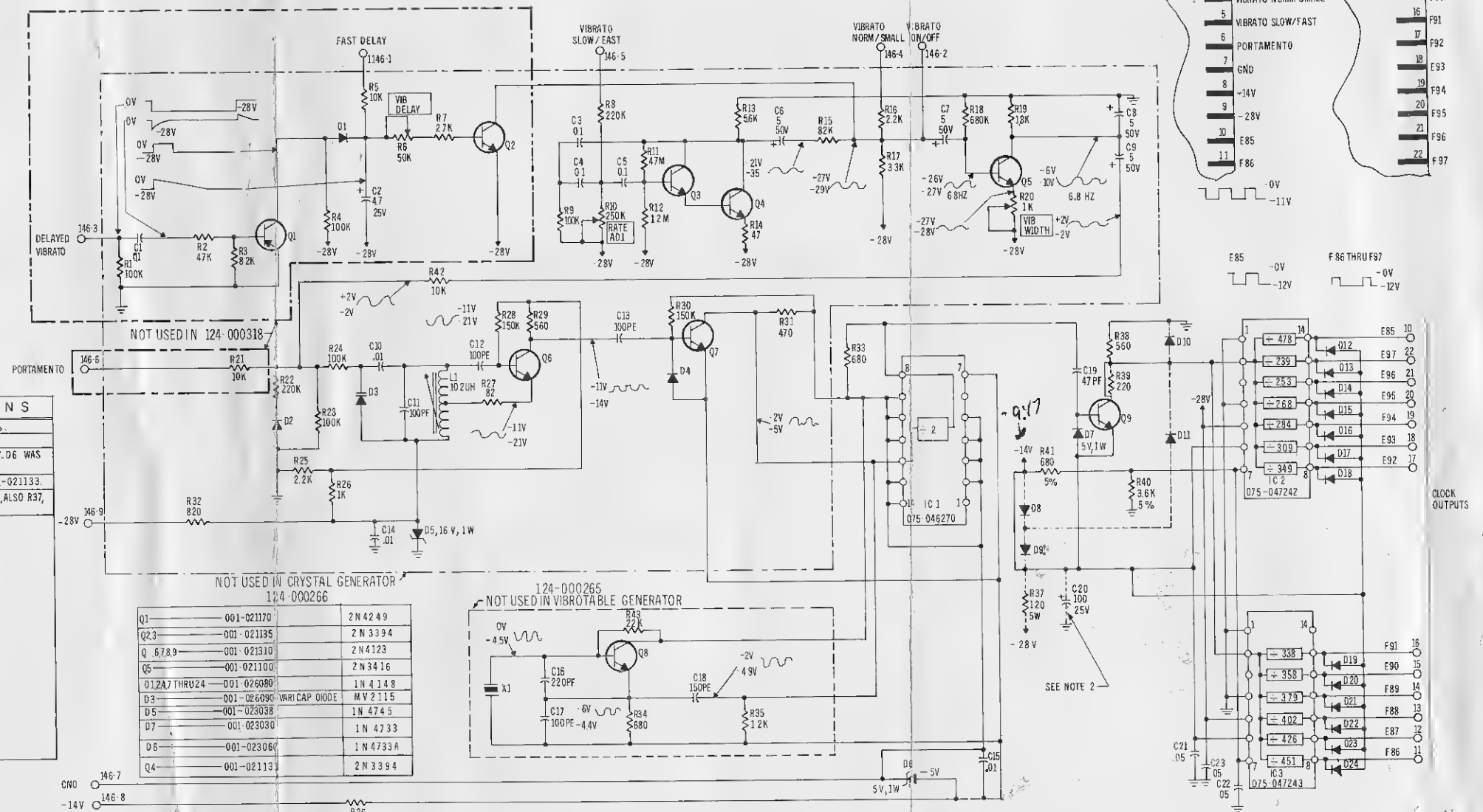
REVISIONS

A	R41 WAS 1000A, 5%.
B	C6 & C7 WERE 50/50V.D6 WAS 001-223030.
C	Q6, Q7 & Q8 WERE 001-021133.
D	DELETED Q8 THRU Q11, ALSO R37, R39 AND C20.
E	

Q1	001-021170	2N4249
Q2	001-021135	2N3394
Q3	001-021310	2N4123
Q4	001-021100	2N3416
Q5	001-026080	1N4148
Q6	001-026090	VARICAP DIODE MV2115
Q7	001-023038	1N4745
Q8	001-023030	1N4733
Q9	001-023056	1N4733A
Q10	001-021133	2N3394

NOTES:

- UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS & 1/2 WATT, ±10%;
ALL CAPACITORS ARE IN MICROFARADS.
- COMPONENTS WITH CONNECTIONS IN DOTTED LINES WERE USED IN EARLIER MODELS, REF. REV. ISSUE "E".



124-000318, 124-000265, 124-000266

094-047241-E

MDD Generator

Components not "boxed-in" by dotted lines are common to both the assemblies. IC1 is a signal divider; it is used to insure a square input signal with a 50 per cent duty cycle to drive the MDD IC packages. This divider (IC1) may be driven by either the crystal oscillator or the vibratoable oscillator. The -5 volts for this IC is generated by D6 and R36 and bypassed by C15.

IC2 and IC3 are the two MDD frequency generators; IC2 generates frequencies F92 through F97 and F85. IC3 generates frequencies F86 through F91. IC1 drives buffer Q9, supplying an 11 volt 1.99936 M HZ. clock signal for the MDD packages. Diodes D10 and D11 supply protection for the clock input gates on the MDD packages.

A 6 per cent decrease in the oscillator frequency (Portamento, or "Auto-Glide") is caused by applying -8 volts to R21 at J146-6.

The oscillator signal is coupled through C13 to buffer amplifier Q7 which drives IC1.

A variation of the vibratoable MDD generator is assembly 124-000318. On this assembly the delayed vibrato circuitry (Q1, Q2, R1, R2, R3, R4, R5, R6, R7, D1, C1, and C2) and the Portamento resistor (R21) are removed. This assembly is used on organs not requiring delayed vibrato or Portamento capabilities.

The 124-000318 MDD assembly is completely interchangeable with the 124-000265 MDD assembly.

Three power supplies, -11 volts, -16 volts, and -28 volts, are required for the operation of the two MDD packages. The -28 volts is supplied from the organ power supply. The -16 volts supply is generated by two diode drops (D8,9) from -14 volts through R37 to -28 volts. R40 and R41 form a voltage divider between ground and -14 volts to generate the -11 volt supply. (The -11 volt current, and the -16 volt supply may draw 24 to 70 MA.) Each of the three supplies is protected from static discharge by a capacitor (C21,22,23). The -16 volt supply is filtered by C20.

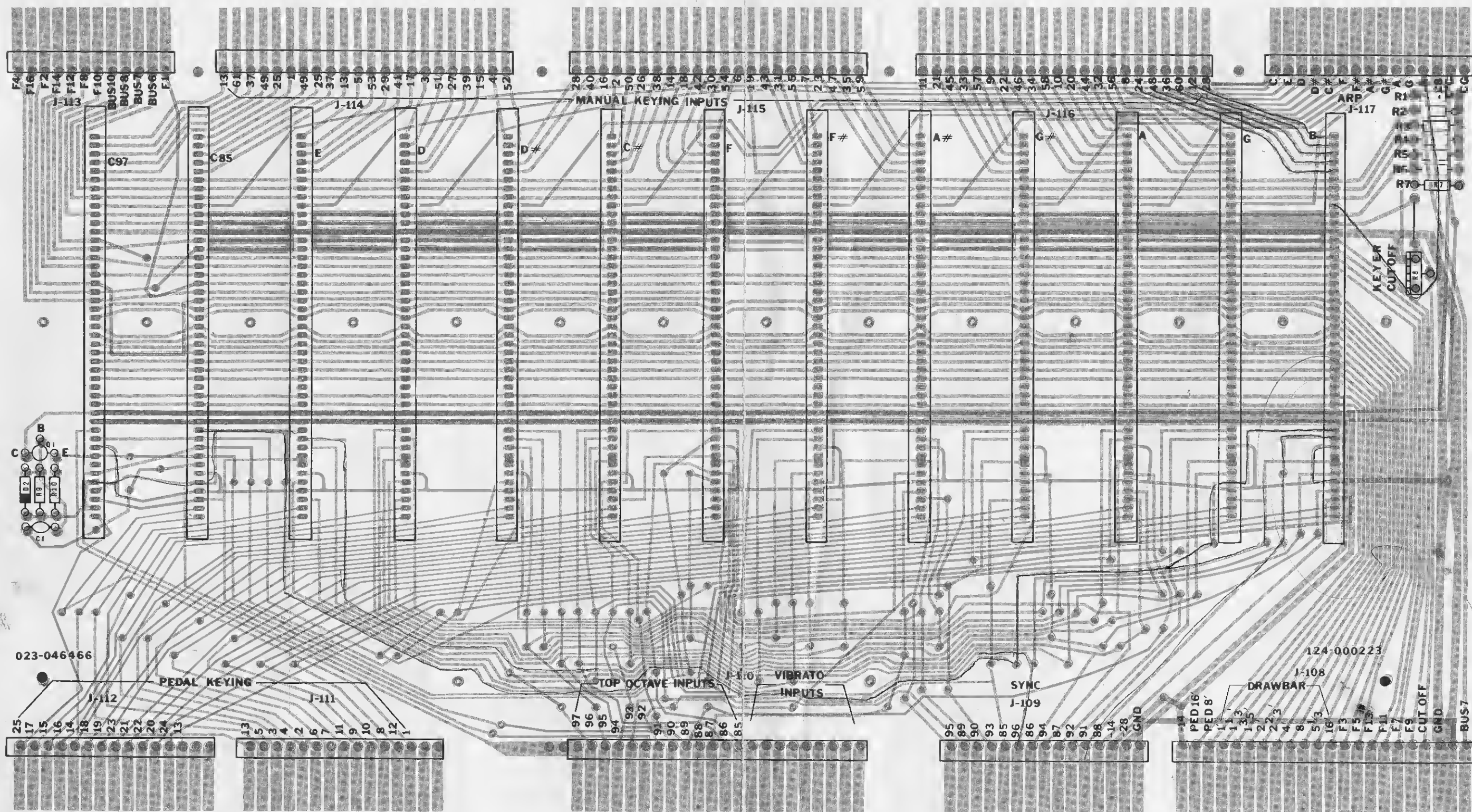
All outputs of the MDD generator IC packages are protected by a diode connected to -16 volts (diodes D12 to D24).

FIGURE 3-4
MDD GENERATOR BOARD
SCHEMATIC, LAYOUT
AND THEORY
(124-000266)

COW

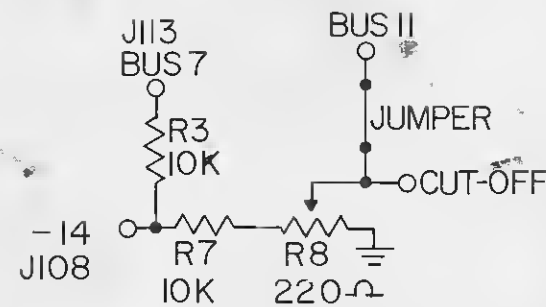
300

CK WITH
AUDIO
FROM FILTER



2

FIGURE 3-5
UPPER MANUAL SYNTHESIS
MOTHER BOARD-SCHEMATIC,
LAYOUT AND THEORY
(124-000223-002)



INPUTS from MOD
124-000222-002 UPPER MANUAL SYNTHESIS MOTHER BOARD

MDD signals (from 124-000266 board) enter at J-110, then go to one of 13 daughter boards (124-000223). A master pulse output from the Lower Manual Synthesis assembly (124-000223) is used to synchronize frequencies used on both manuals and as harmonics of several notes on the same manual, to prevent cancellation effects. When synchronizing output is missing, the odd harmonics (Black Tonebars) usually will not sound. The tonebar inputs (J108) come from the tonebar stop switches via the Preset Mother Board (124-000243). This negative D.C.

voltage adjusts the keyer supply voltage and therefore the square-wave output current. To minimize the interaction between keyers feeding the same filter, the input impedance of the filter is 100 ohms or less. Therefore, the output voltage at the filter terminals (J108 and J113) is very low when the filters are connected. A keyer cut-off control near J117 adjusts the decay limit of the keying voltage during sustain. J114, J116, and J117 are marked with key numbers. These are the upper manual outputs.

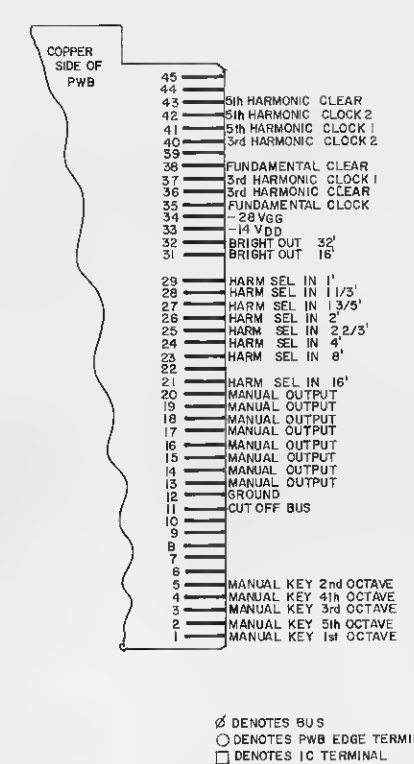
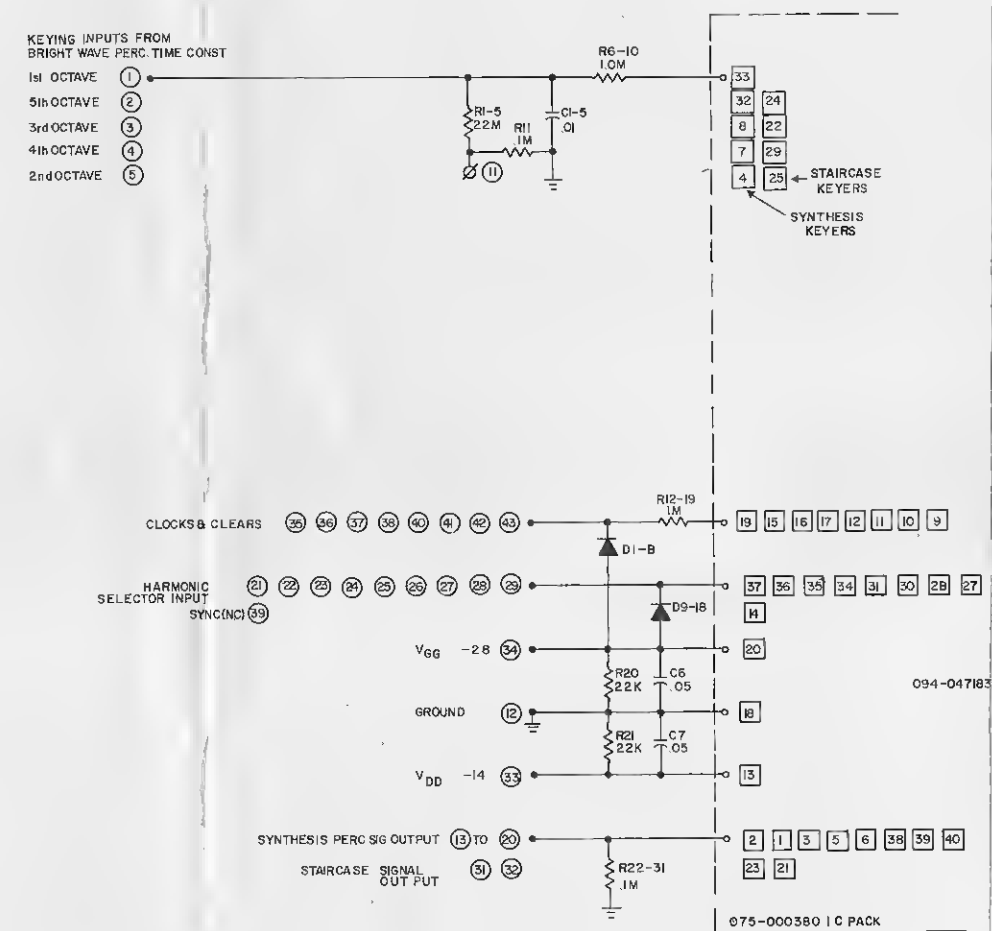
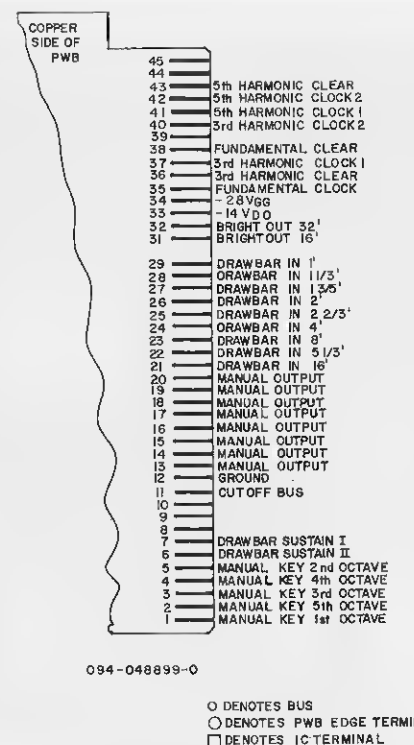
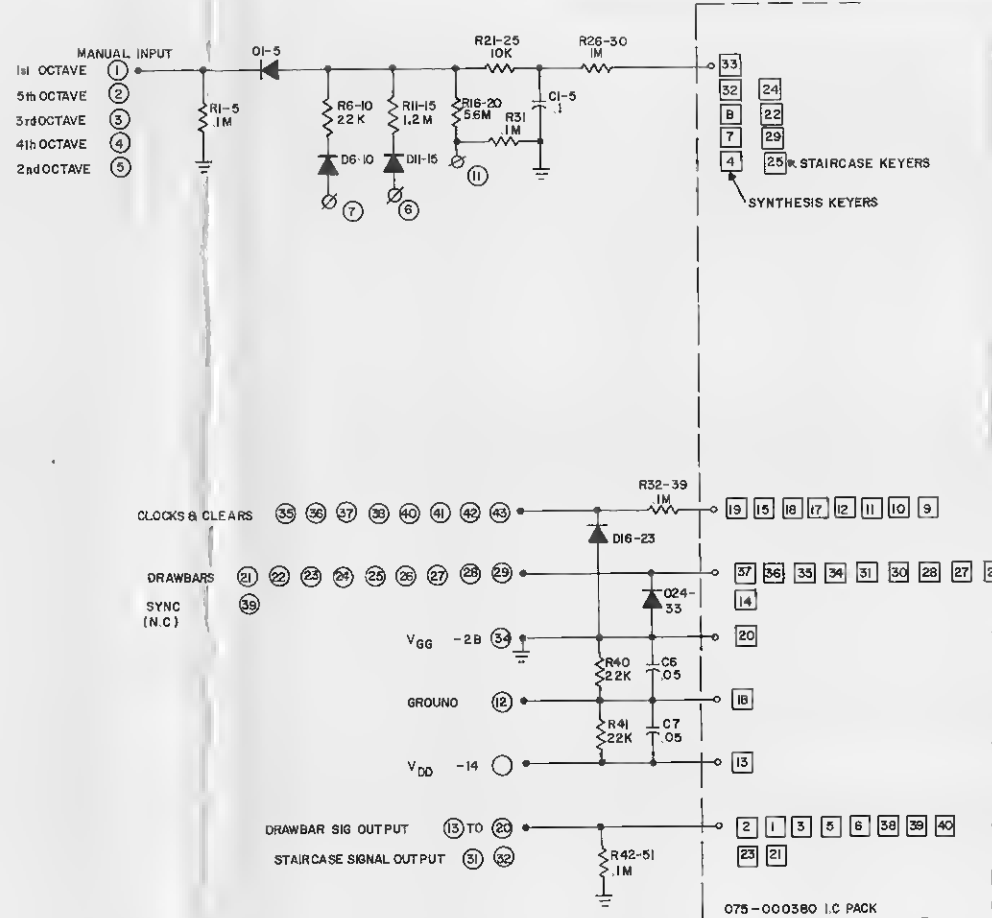
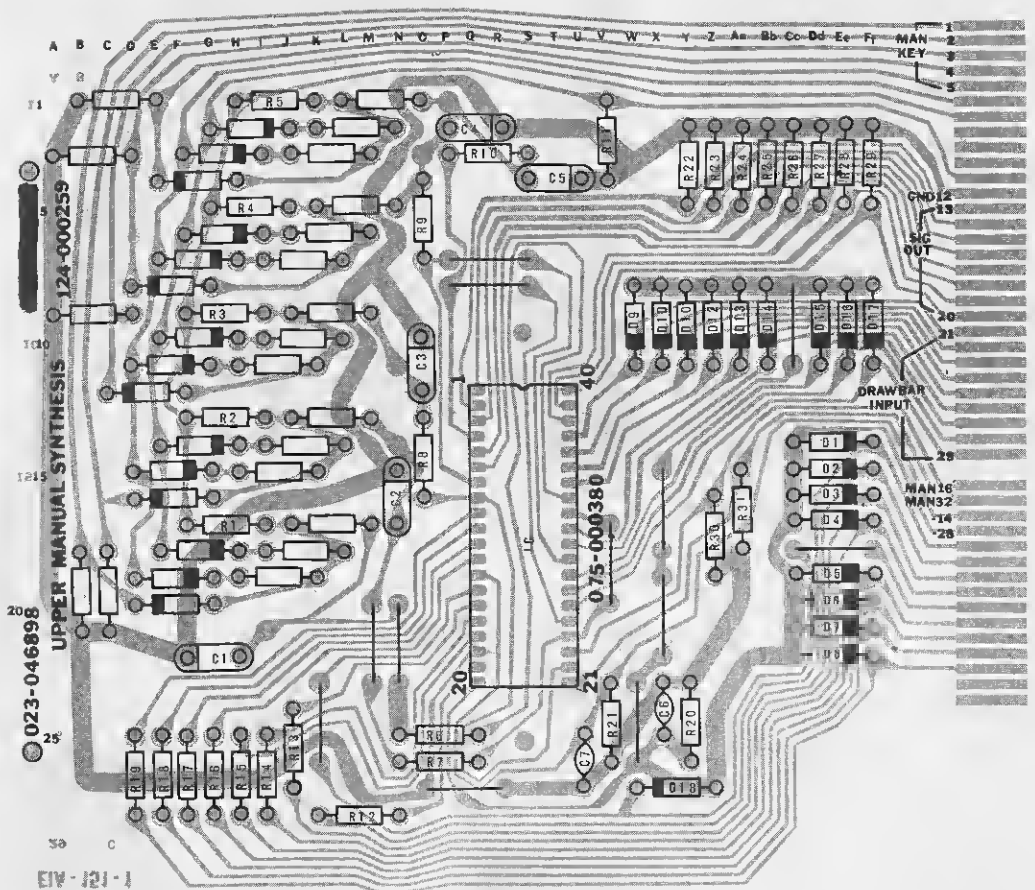
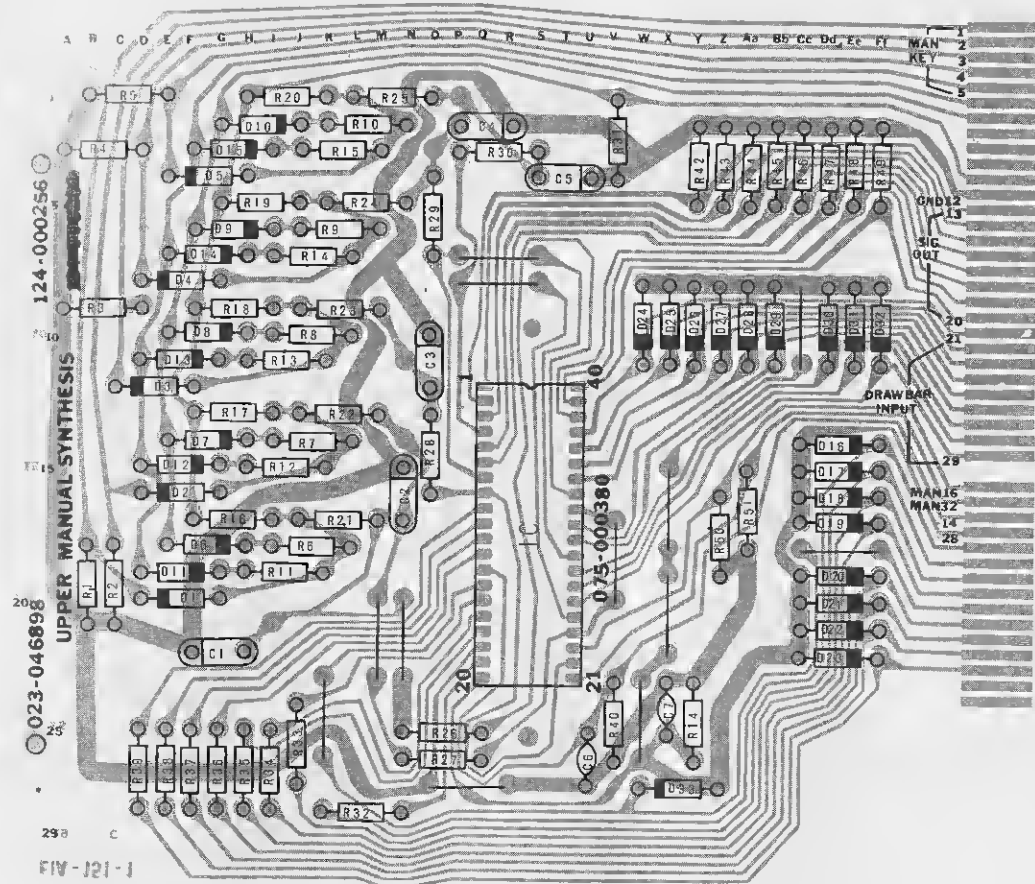
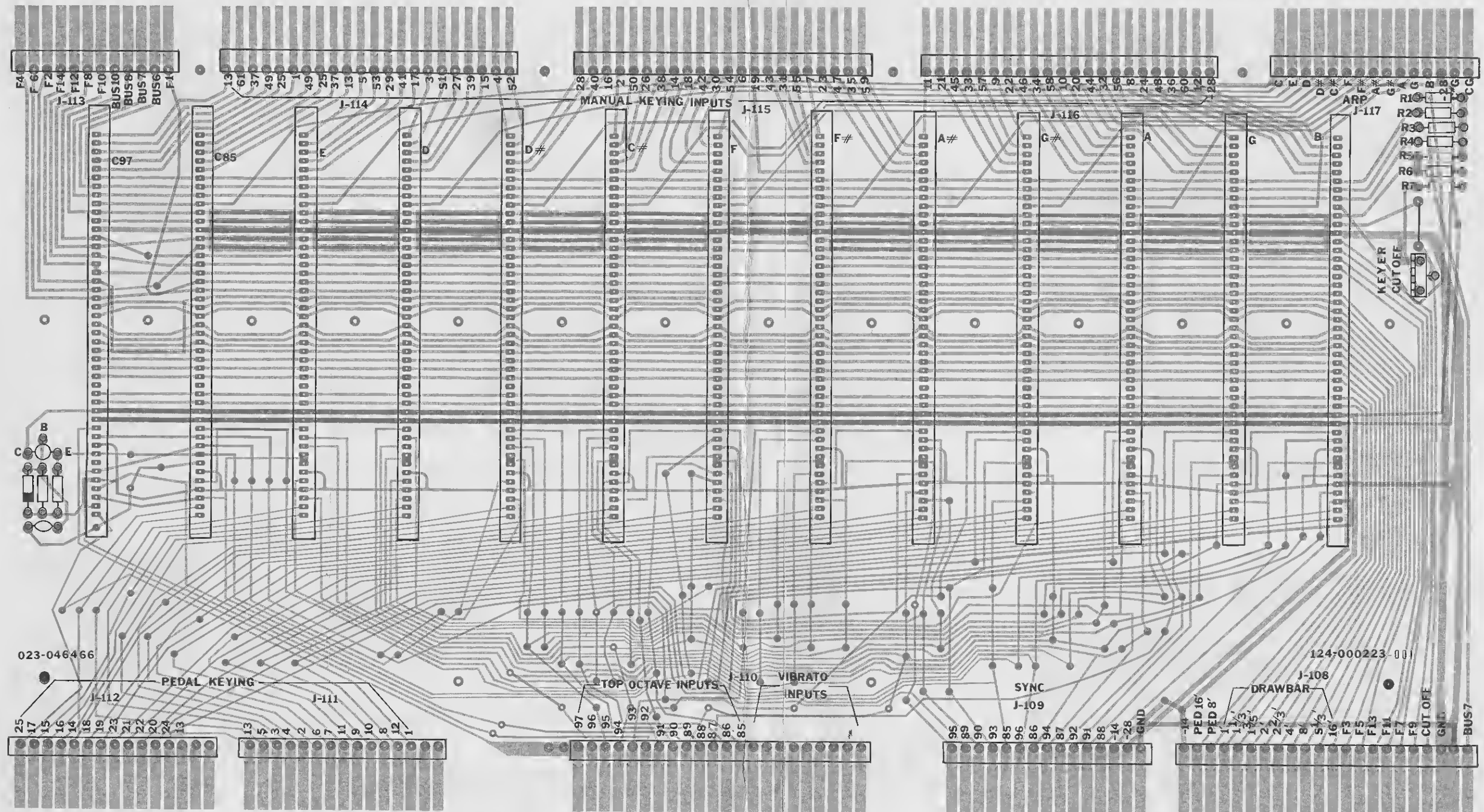


FIGURE 3-6
U/M SYNTHESIS DAUGHTER BD.
(124-000256)
SYNTHESIS PERCUSSION DAUGHTER BD.
(124-000259)

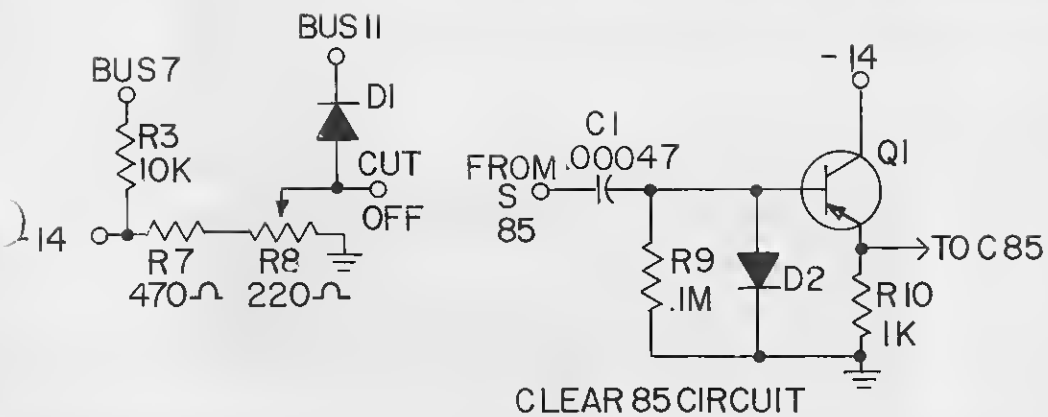
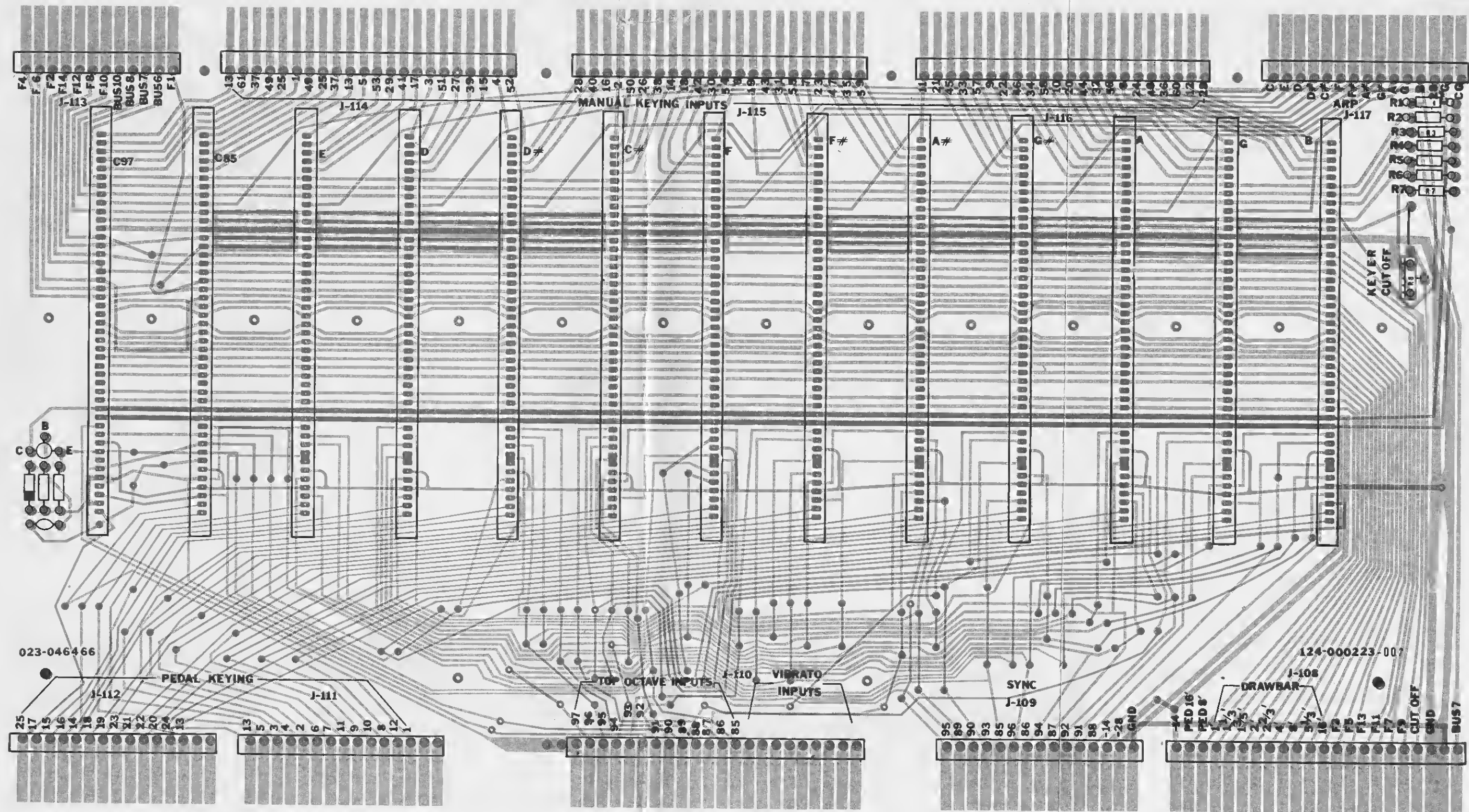


SYNTHESIS PERCUSSION MOTHER BOARD
(124-000223-001)

Associated with 13 Daughter Boards, (124-000259) this assembly generates square-wave outputs in a similar manner to other 380 IC systems in the instrument. However, in this case, keying outputs are supplied from an external source, the Bright Wave Percussion Boards, (124-046769 and 124-046769-001) which provide a percussion envelope as well. These

signals enter Mother Board at J-114, J-115, and J-116, then go to proper Daughter Board, passing through an additional percussion time constant (R1, R11, C1, R6) before reaching the PWB octave input terminals. (1 through 5) repeat and alternate repeat pulses enter Mother Board at J-108. Signal outputs to sine filters are at J-113.

FIGURE 3-7
SYNTHESIS PERCUSSION
MOTHER BOARD-LAYOUT
AND THEORY
(124-000223-001)

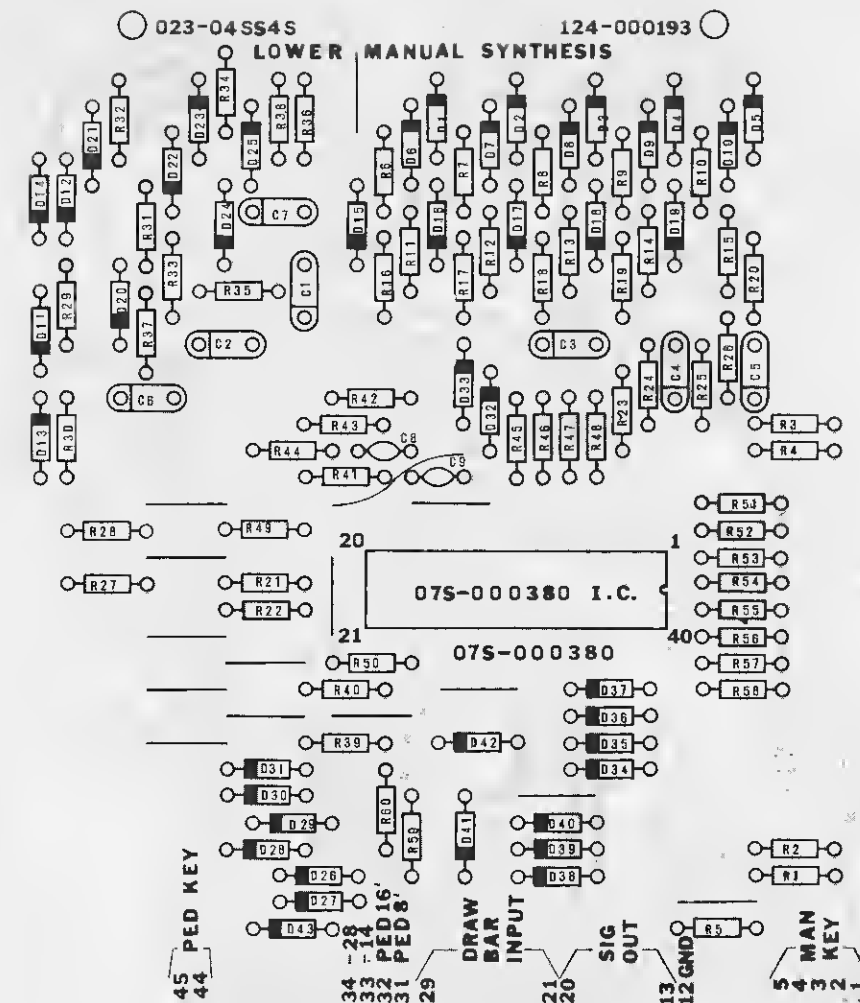
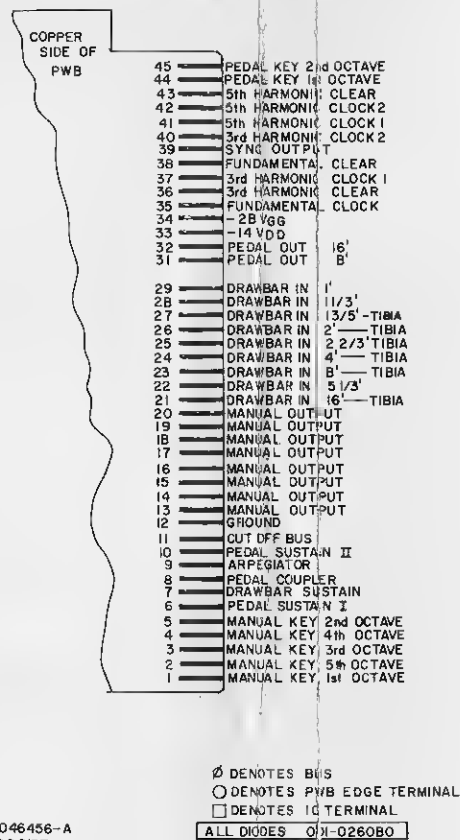
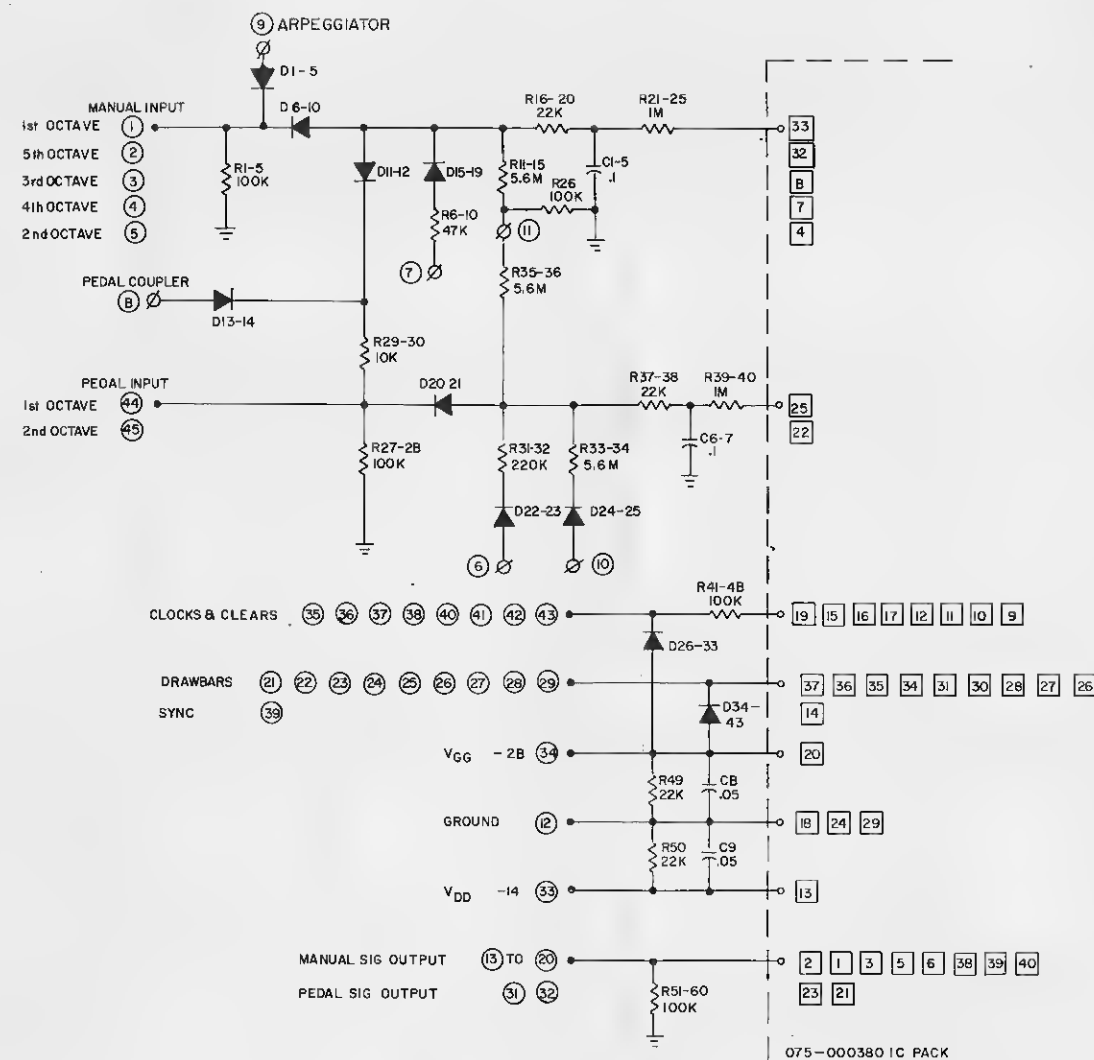


123-000223 LOWER MANUAL SYNTHESIS MOTHER BOARD

The action of the Lower Manual Synthesis assembly is in many respects, the same as the other "380" components, it has some additional functions, however, such as: 1. Pedal keying, utilizing the stair-step-wave outputs on the "380" IC's. 2. Producing a pulse signal output at J109 for the synchronization of all generator

keyers, and 3. Providing inputs for the Arpeggiator keyboard, (124-047850) at J117. J111 and J112 are outputs to Pedal Filter Board (124-000206). There is no synthesis or bright percussion available on the lower manual.

FIGURE 3-8
LOWER MANUAL SYNTHESIS
MOTHER BOARD - LAYOUT
AND THEORY
(124-000223)



7

FIGURE 3-9
LOWER MANUAL SYNTHESIS
DAUGHTER BOARD-SCHEMATIC,
LAYOUT AND THEORY
(124-000193)

"380" ASSEMBLY

Each "380" I.C. handles all octaves and harmonics (footages) of one note letter on one manual (for example: all harmonics of all D-notes on the lower manual). To do this requires three top octave (clock) inputs per I.C.: fundamental, third harmonic, and fifth harmonic. Frequency divider chains inside the IC, divide these down to the required frequency. In order to keep the third and fifth harmonic clocks within the same top octave for all notes, there are two clock inputs for these harmonics, one above the fundamental, and the other below. Only one of these is used for a particular note.

Sync: Since the same frequency is used on both manuals and as harmonics of other notes on the same manual, these frequencies must be locked together in phase to prevent possible cancellation effects. This sync output is obtained from the lower manual assembly which acts as a master and applied to the other assemblies via the sync terminals. (J-109).

These sync pulses are very narrow (1/512 duty cycle) and cannot normally be seen on a scope. Feed this into an amplifier and listen to it. A 47K resistor and a .22 uFd capacitor in series with a test lead connected to terminal 11 of J101 on Sine Filter Board 124-000201 works well.

Top Octave: The top octave inputs come from the Multiple Derivative Divider(MDD) via J-110.

Filter: Since the outputs of the manual keyers are square waves, they must be filtered to produce the desired sine waves. To minimize the interaction between keyers feeding into the same filter, the input impedance of the filters is made 100 ohms or less. Thus, the output voltage at the filter terminals of J-108 and J-113 is very low when the filters are connected.

Sustain: Sustain causes a note to linger on for a short period of time after the key is

released. This is done by forward (0V) or reverse biasing (-14V) diodes in series with the sustain resistors on the daughter boards by means of the sustain busses on J-108 and J-113. The pedal sustain comes directly from the pedal sustain switches on the control panel.

Keyer Cut Off: This control adjusts the voltage to which the keying voltage decays during sustain. Adjust to -2.5 volts at the center contact (cut-off bus). If ciphering is noticed with sustain for that manual activated, back off the control until this disappears.

C 97: Since there are more C's than any other note, an extra "C" board had to be added. This takes care of the top C on the pedals and C25 and up on the manuals. This leads to sync problems, so the C sync signal is taken from the C85 board and differentiated by a separate transistor on the lower manual mother board to narrow it down so it can be used to sync both "C" dividers.

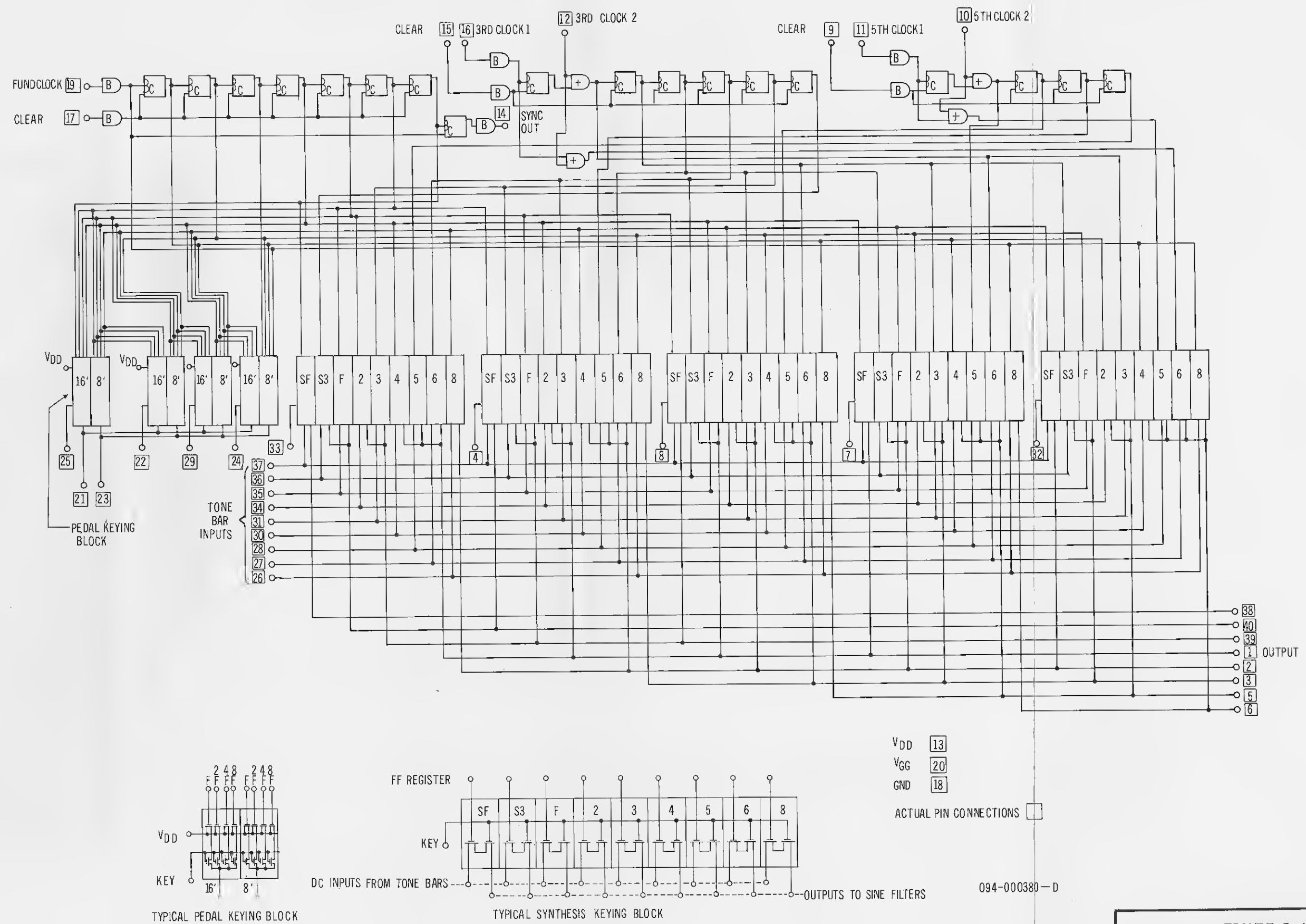
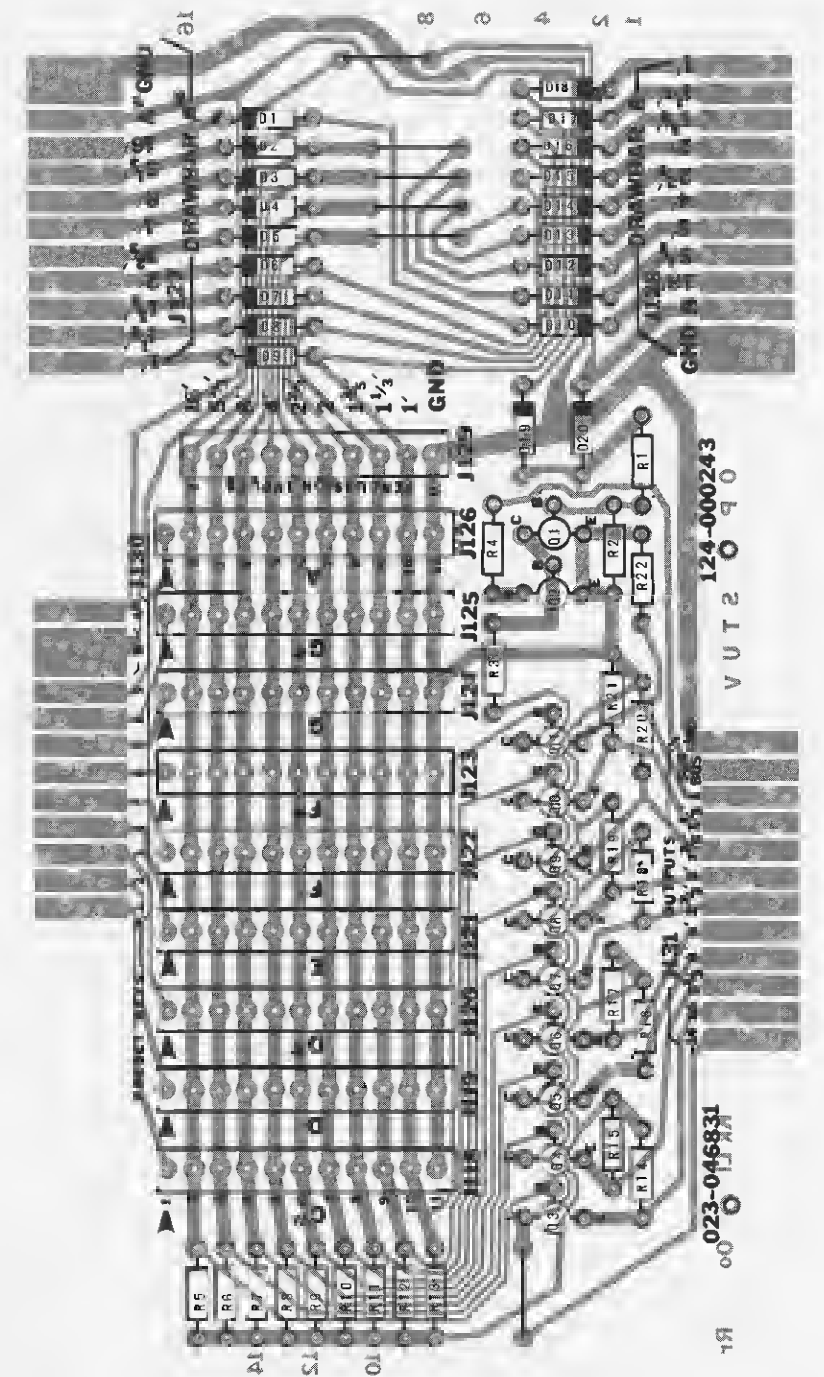
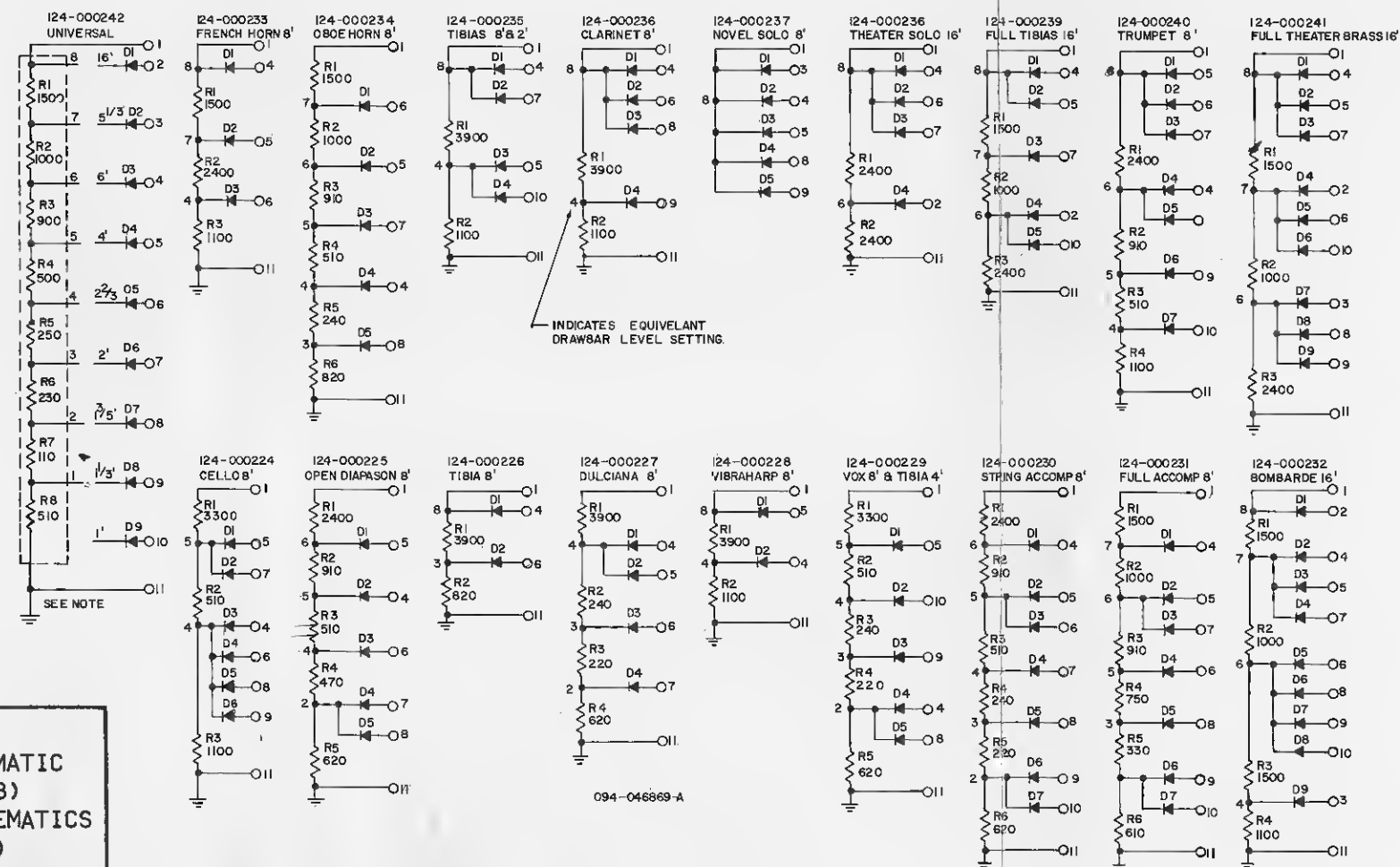
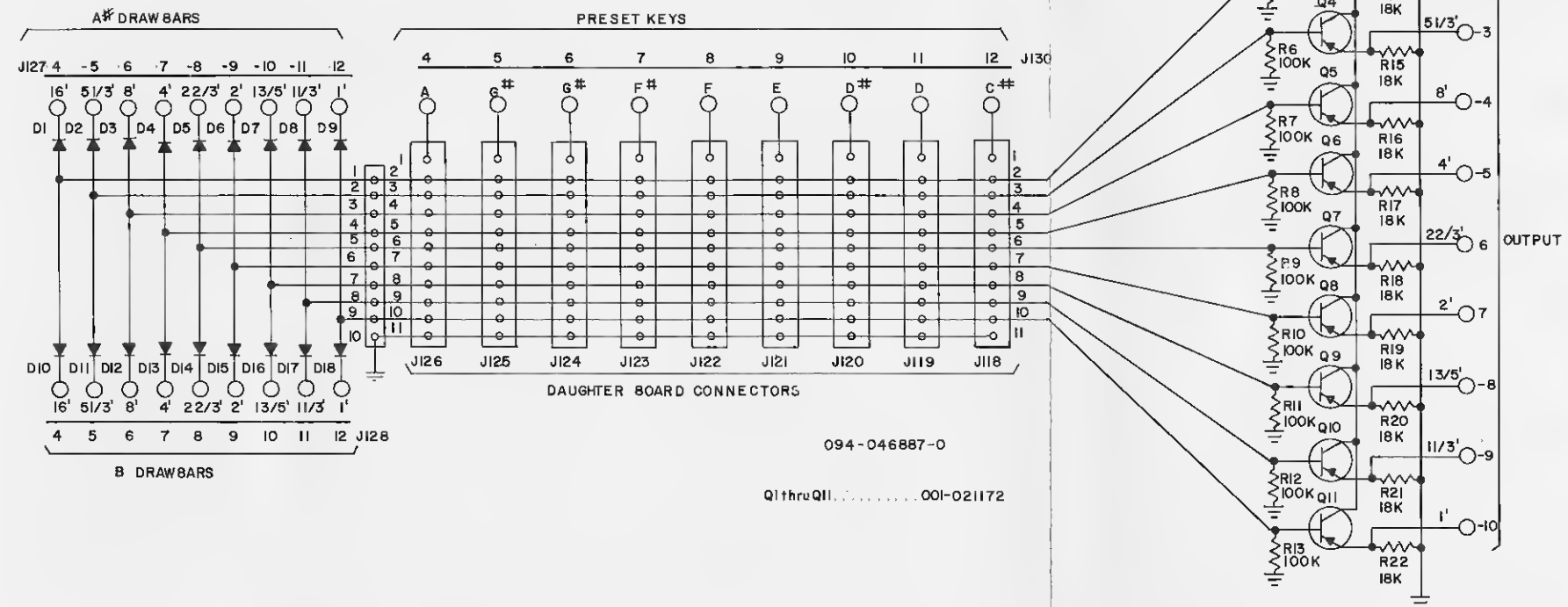
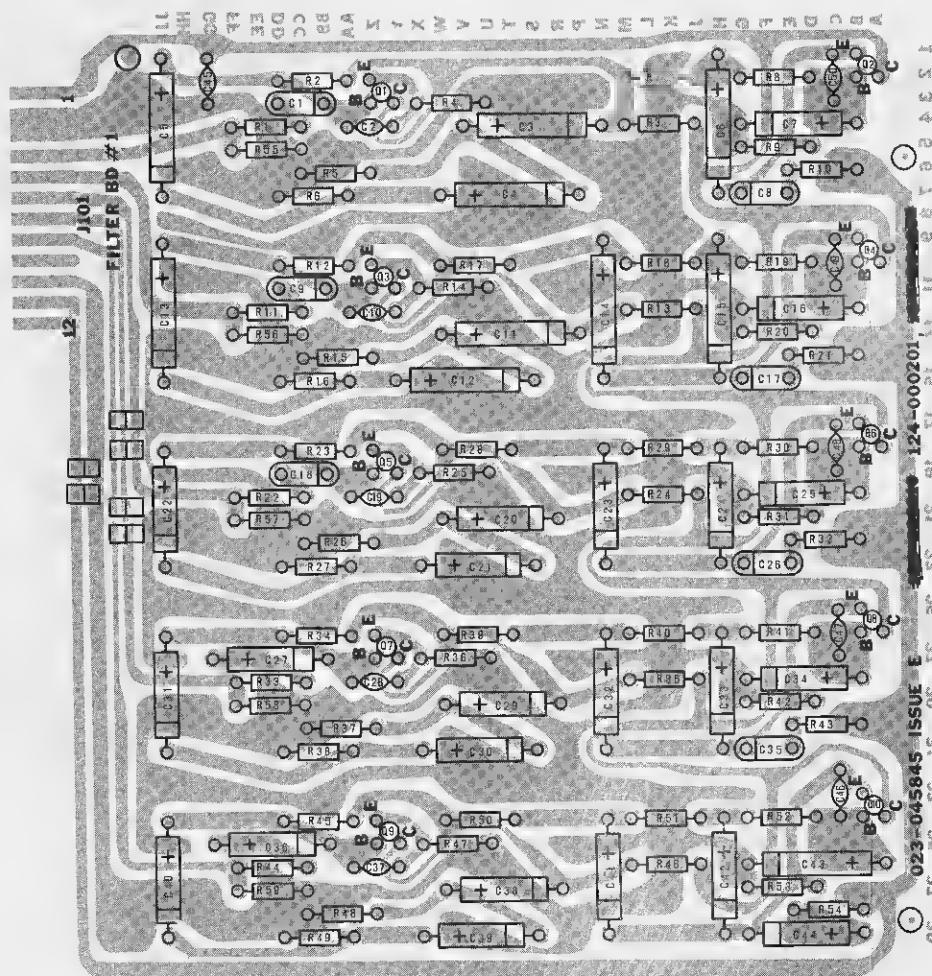


FIGURE 3-10
 I.C. 380 DIVIDER
 KEYER PACKAGE-SCHEMATIC
 (075-000380)



8

FIGURE 3-11
PRESET MOTHER BOARD-SCHEMATIC
AND LAYOUT-(124-000243)
PRESET DAUGHTER BOARDS-SCHEMATICS
(124-000224 THRU 242)



124-000201, 124-000202, 124-000204.

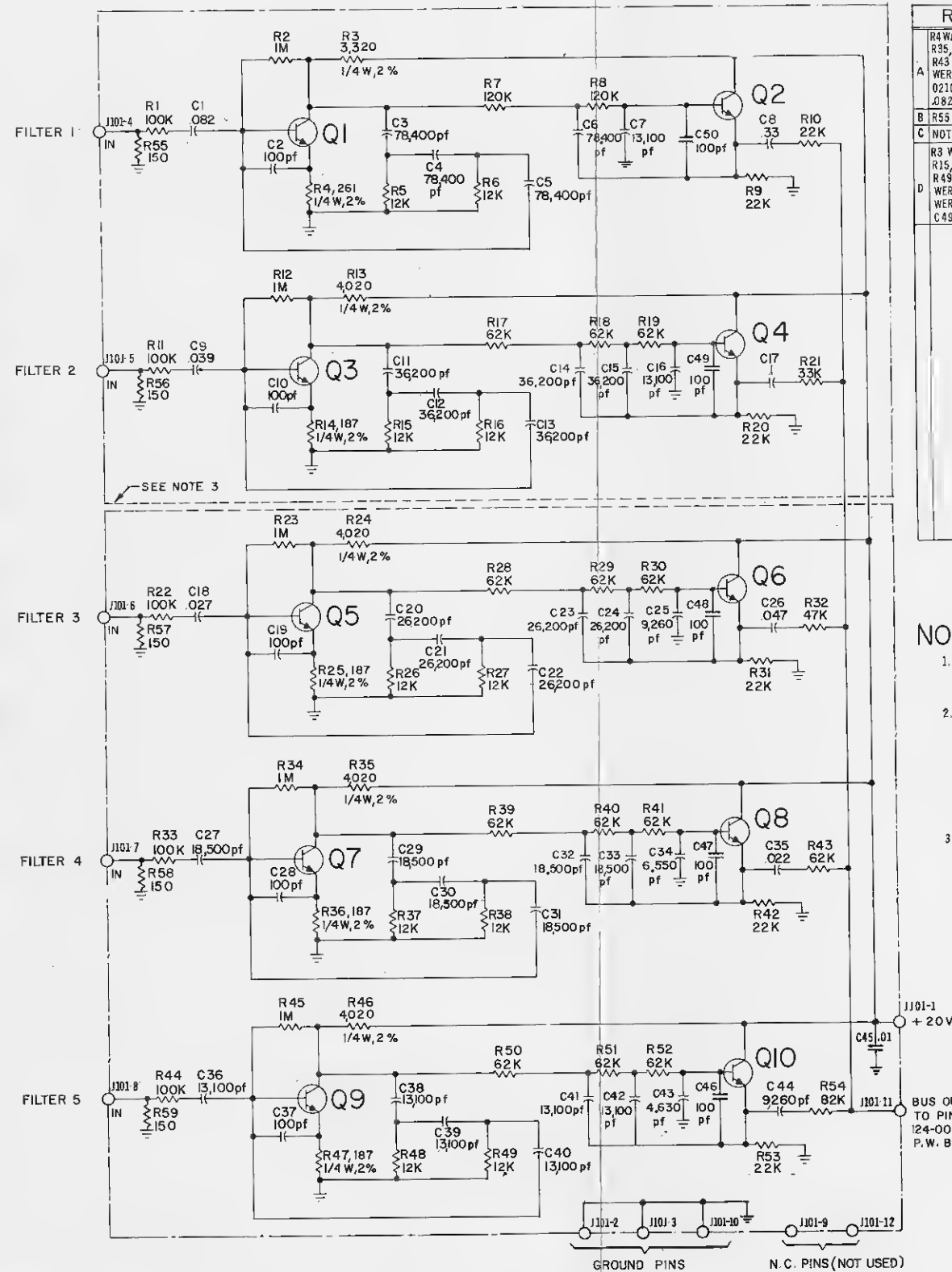
SINE WAVE FILTER BOARDS.

These printed wiring boards work together as a unit. There are 14 filter groups in each set to match the 14 signal output terminals of a typical 380 assembly. Each group passes one 12 interval octave plus one note, with the exception of group #1, which is for frequency #1 thru #12 only. Pass bands of the filter groups overlap by necessity due to the combination of pitches on the 380 outputs. A total range of 8 octaves is available. (frequency #1 thru #97). On the first five groups, a 150 ohm resistor is used at the input to develop the square wave output current from the 380 keyers into a signal of approximately 80 mv peak to peak for one note at tonebar position 8. On all remaining groups the keyer current is summed in a bus amplifier input of very low impedance (10 ohms). The output current at the collector of this stage is the same amplitude as is developed across the 150 ohm resistors on the first five groups. The bus amp is used to prevent IM distortion from interaction between the IC keyers. It is not needed on the lower frequency groups because the IM difference frequencies are most sub-audible. Most of the filter groups are two stage, 8 pole, active band-pass filters. The first stage has a pronounced peak near the top of the pass band. The second stage starts the roll-off just above the low end of the pass band, a combination which provides a reasonably flat pass-band with a sharp attenuation curve. Input and output coupling capacitors are used to reduce keying thumps by providing low frequency roll-off. Filter group #1 has one RC section deleted as the sine wave purity requirements are not as severe at low frequencies. Filter group #14 has only one stage since the harmonics are at the upper limit of hearing. All signals from the 124-000201 and 124-000204 boards go to the 124-000202 board where Q13, a phase diverter, sums the outputs of groups one thru five which do not have bus amplifiers. The remaining signals along with those from the

phase inverter feed into Q14, an output amp on the 124-000202 board. Mixing resistors in the output of each filter group are selected to provide the necessary tapering. (Higher output at lower frequencies).

TVI suppression capacitors are provided and isolating resistors are used to prevent failure of the output amp or the phase inverter.

NOTE: Earlier versions of these boards do not have TVI suppression capacitors or isolation resistors.



QTY	DESIGNATION	SYMBOL	HAMMOND PART NO	JEDEC PART NO
5	Q1, Q3, Q5, Q7, Q9		001-021260	2N5826
5	Q2, Q4, Q6, Q8, Q10		001-021135	2N3394

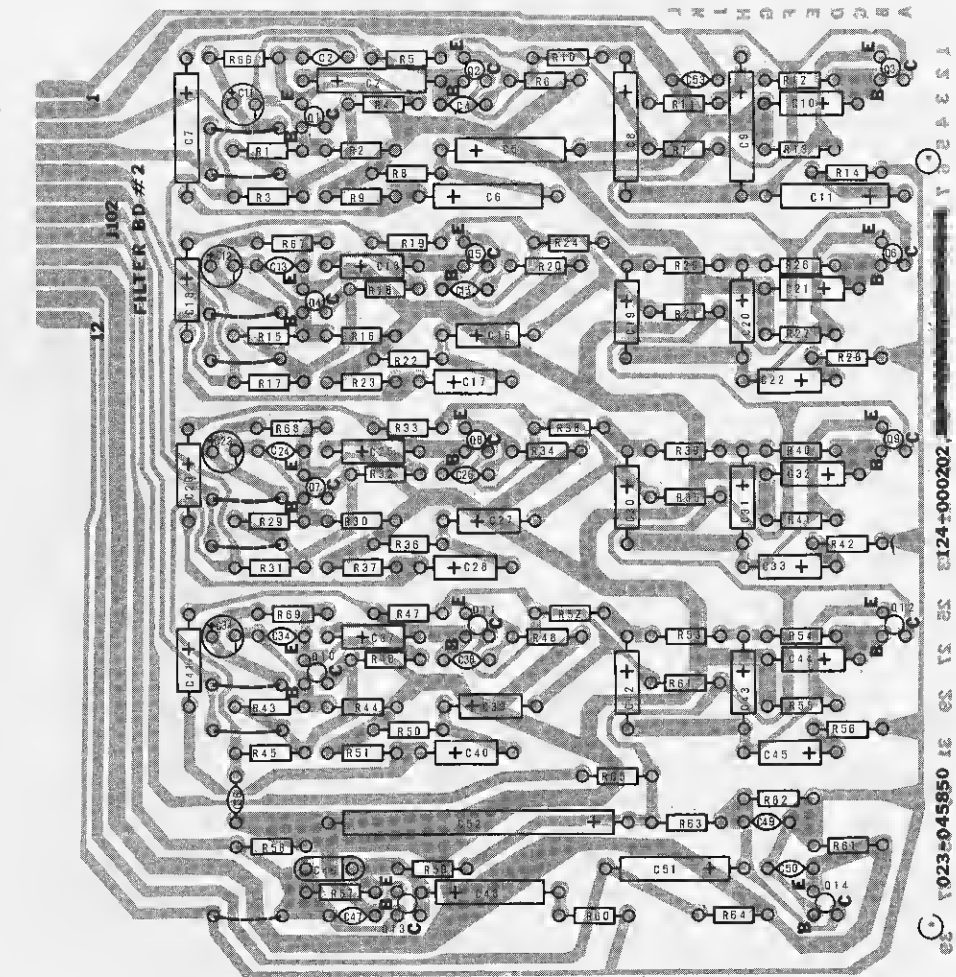
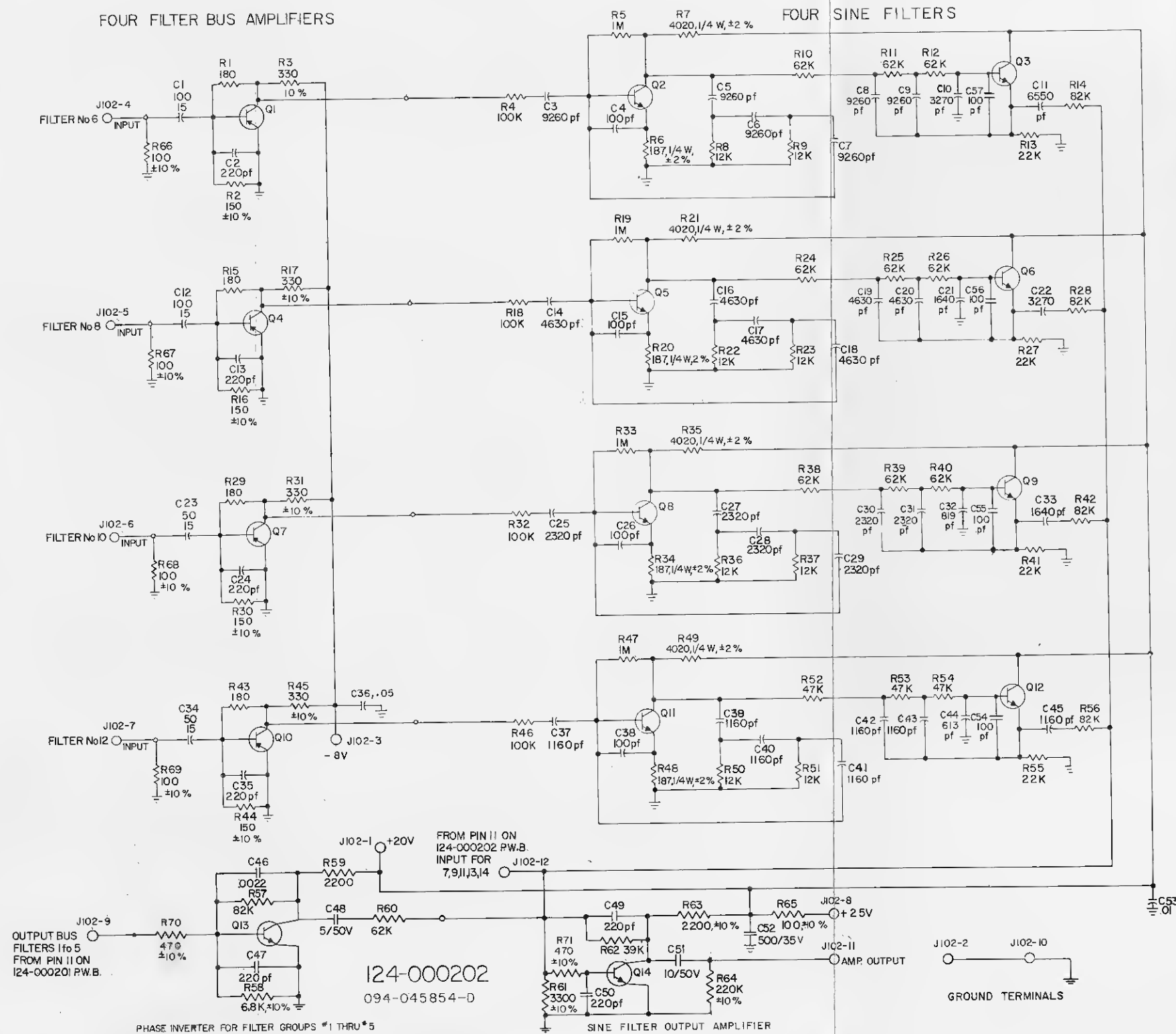
124-000201/124-000310
094-045849-D

9

FIGURE 3-12
SINE WAVE FILTER #1
SCHEMATIC, LAYOUT AND
THEORY (124-000201)

REVISIONS	
A	R4 WAS 220K. R10 WAS 27K. R13, R24, R35, R46 WERE 3.3K. R21 WAS 39K. R43 WAS 68K. R14, R25, R36, R47 WERE 150K. Q5, Q7, Q9 WERE 001-021070. C8 WAS .27MF. C17 WAS .082MF. C44 WAS 13,100PF.
B	R55 THRU R59 WERE 100K.
C	NOTE 3 ADDED.
D	R3 WAS 3.3K. R4 WAS 270K. R5, R6, R15, R16, R26, R27, R37, R38, R48 & R49 WERE 13K. R14, R25, R36, R47 WERE 180K. R13, R24, R35, R46 WERE 3.9K. ADDED C46, C47, C48, C49 & C50, C7 CONNECTED TO GROUND.

- NOTES:
- IF OTHERWISE NOT SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 5\%$.
 - CAPACITOR VALUES ARE, AS FOLLOWS:
POLYSTYRENE CAPACITOR VALUES ARE IN PICO FARADS, $\pm 2.5\%$;
MYLAR CAPACITOR VALUES ARE IN MICROFARADS, $\pm 10\%$;
ALL 100 PF CAPACITORS & C45 ARE CERAMIC, $\pm 10\%$.
 - FILTERS #1 & #2 ARE NOT USED ON P.W. BOARD 124-000310.



NOTES:

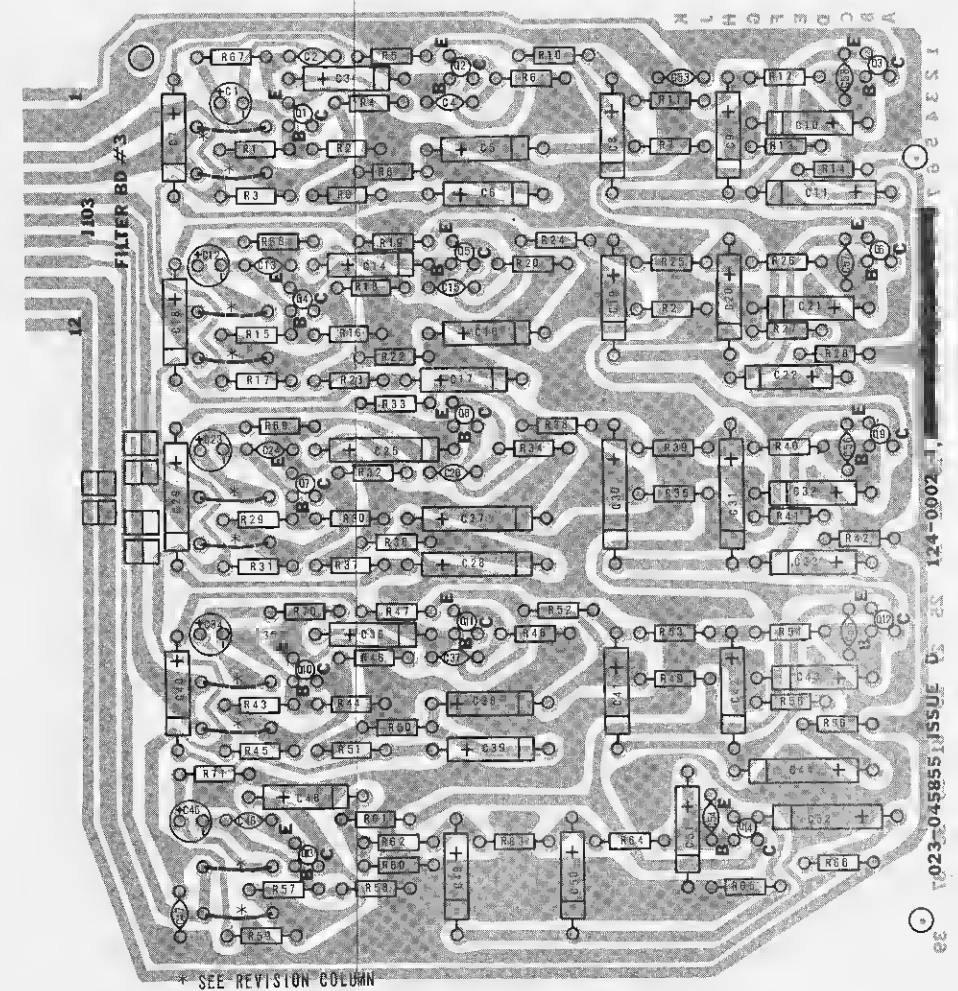
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 5\%$.
2. MYLAR CAPACITOR VALUES, $\pm 10\%$ AND ELECTROLYTIC CAPACITOR VALUES, SHOWN WITH WORKING VOLTAGE, ARE IN MICROFARADS.
3. POLYSTYRENE CAPACITOR VALUES ARE IN PICO FARADS, $\pm 2.5\%$.
4. CAPACITORS WITH VALUES OF 100PF, 200 PF AND C53 ARE CERAMIC, $\pm 10\%$.

QTY	DESIGNATION	SYMBOL	HAMMOND PART #	JEDEC PART #
4	Q1, Q4, Q7, Q10		001-021172	2N 4249
6	Q2, Q5, Q8, Q11, Q13, Q14		001-021260	2N 5826
4	Q3, Q6, Q9, Q12		001-021135	2N 3394

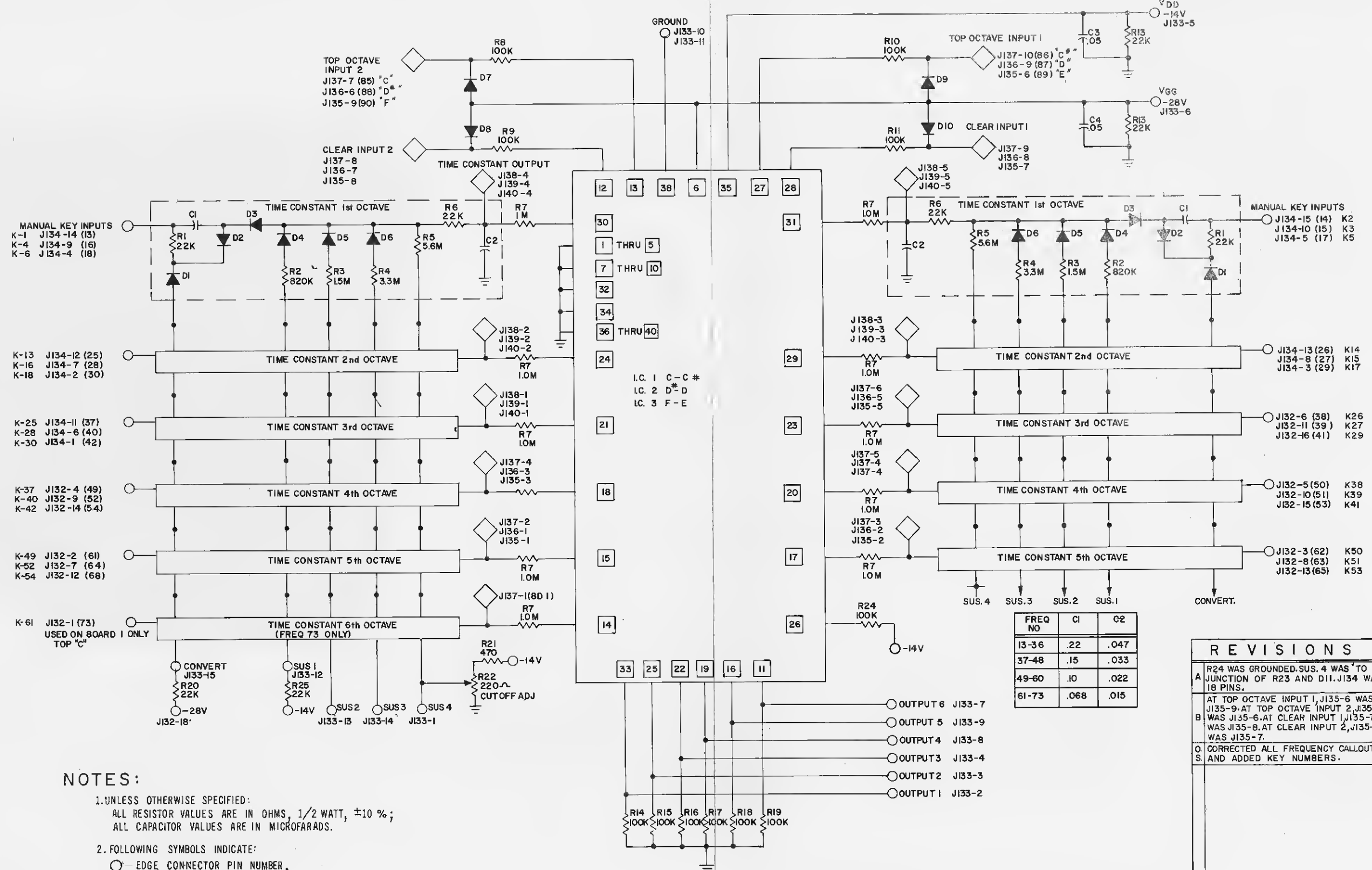
R E V I S I O N S			
A	*SPINETS ONLY* DELETED FROM NOTE 2.	D	WERE 13K, R70 & R71 ADDED. Q13 & Q14 WERE 001-021135.
B	R2, R16, R30 & R44 WERE 120 Ω . R7, R21, R35 & R49 WERE 3.3 K. R6, R20 & R34 WERE 150 Ω . R48 WAS 130 Ω . R61 WAS 6800 Ω . R62 WAS 82 K. Q2, Q5, Q8, Q11 WERE 001-021070. C49 WAS 100 PF. C11 WAS 9260 PF. C22 WAS 4630 PF. C33 WAS 2320 PF.		
C	R1, R15, R29 & R43 WERE 120 Ω . R2, R16, R30 & R44 WERE 330 Ω .		
D	ADDED C54 THRU C58, R6, R20, R34 & R48 WERE 180 Ω . R7, R21, R35 & R49 WERE 3.9 K. R8, R9, R22, R23, R36, R37, R50 & R51		

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FIGURE 3-13
SINE WAVE FILTER #2
SCHEMATIC, LAYOUT
AND THEORY
(124-000202)



2100 CONCORDE 3-15

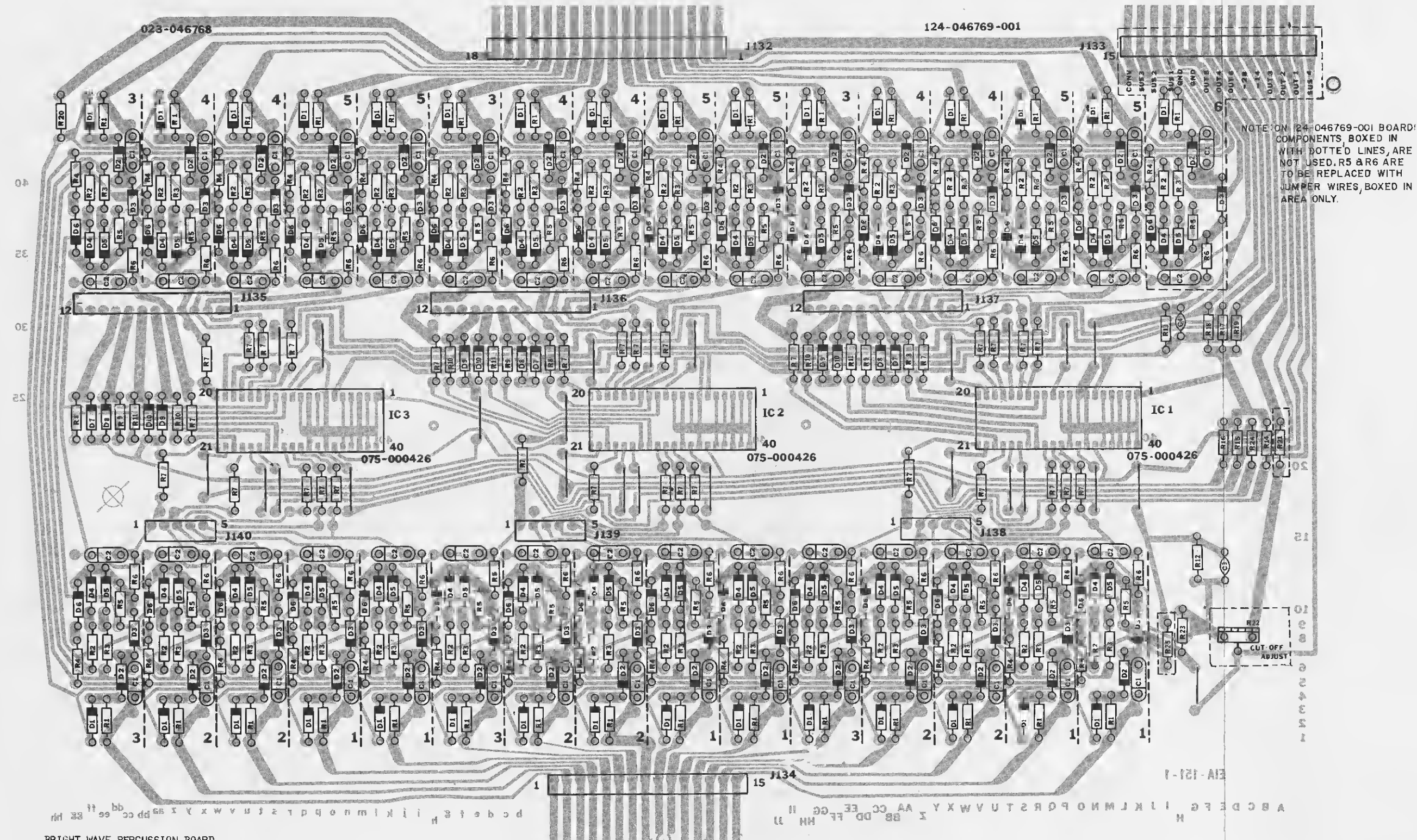


NOTES:

- UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 10\%$;
ALL CAPACITOR VALUES ARE IN MICROFARADS.
- FOLLOWING SYMBOLS INDICATE:
○—EDGE CONNECTOR PIN NUMBER,
□—I.C. PIN NUMBER,
◇—UPRIGHT POST CONNECTOR,
()—FREQUENCY NUMBERS IN PARENTHESIS.
K—KEY NUMBER

FIGURE 3-15
BRIGHT WAVE PERCUSSION
BOARD - SCHEMATIC
(124-046769)





BRIGHT WAVE PERCUSSION BOARD
(124-046769 AND 124-046769-001)

This system supplies stairstep signals for all "bright" voices, (Pizzicato 1, 2, Piano, Piano Solo, Harpischord, and Banjo), plus keying outputs and percussion time constants for the Synthesis Percussion assembly. (124-000223-001). All percussive tones except those from the rhythm units are keyed from the 426 IC assemblies. IC keyers (075-000426) combine octavely related square waves in the correct proportions to produce a stairstep configuration. Each 426 IC supplies outputs for all octaves and pitches for 2 notes on the upper manual. (For example: Five pitches of F# and G notes on the upper manual). Dividers inside the IC, divide down the Clock (Top Octave) inputs, (J-135, J-136, J-137) to the frequencies required by the keyers. A negative DC voltage

(-28 V) is applied to the keyers to turn on all pitches of that note. The outputs of each pitch are combined by octave for group filtering, when necessary. To minimize interaction between keyers feeding the same filter, the input impedance of the filter is made 100 ohms or less. Consequently, the output voltage at the filter terminals (J-133, 2, 3, 4, 7, 8, 9) is very low when the filters are connected. To obtain a suitable envelope, a percussion time constant circuit is connected between key inputs and the IC keyers. The capacitor in series with the input (C1 on schematic 094-045062) passes an initial spike as the key switch is closed. As the switch remains closed, R2 to R5 drain off the charge on the keyer

side of C1 toward the cut-off bias set at SUS-4. If key is released, immediately, C2 discharges through the same resistors, giving a short key-up tail to the note. D3 prevents discharging through the input circuit. R6 works with C1 and C2, slowing down the attack time to minimize "key click". For repeat and alternate repeat modes, percussion keyers must be converted to straight-through keying. (See Repeat Oscillator and Detector Board 124-000260) This is accomplished when -28 V is applied to J-133-15, allowing R1 and D2 to discharge C1 quickly. To prevent cancellation effects, the 426 IC outputs are synchronized with the other Concorde keyer-generator systems. A "master" sync signal from J-109 on the Lower Manual Synthesis Mother Board (124-000223) enters the clear inputs of the IC's (J-135-7, 8/ J-136-7, 8, / J-137-8, 9) causing them to act as "slaves". Keyer cut-off control R22, located on the 124-046769 board, is used to adjust the point to which the keying voltage decays during the sustain portion of the percussion mode.

FIGURE 3-16
BRIGHT WAVE PERCUSSION
BOARD-LAYOUT AND THEORY
(124-046769 and 124-046769-001)

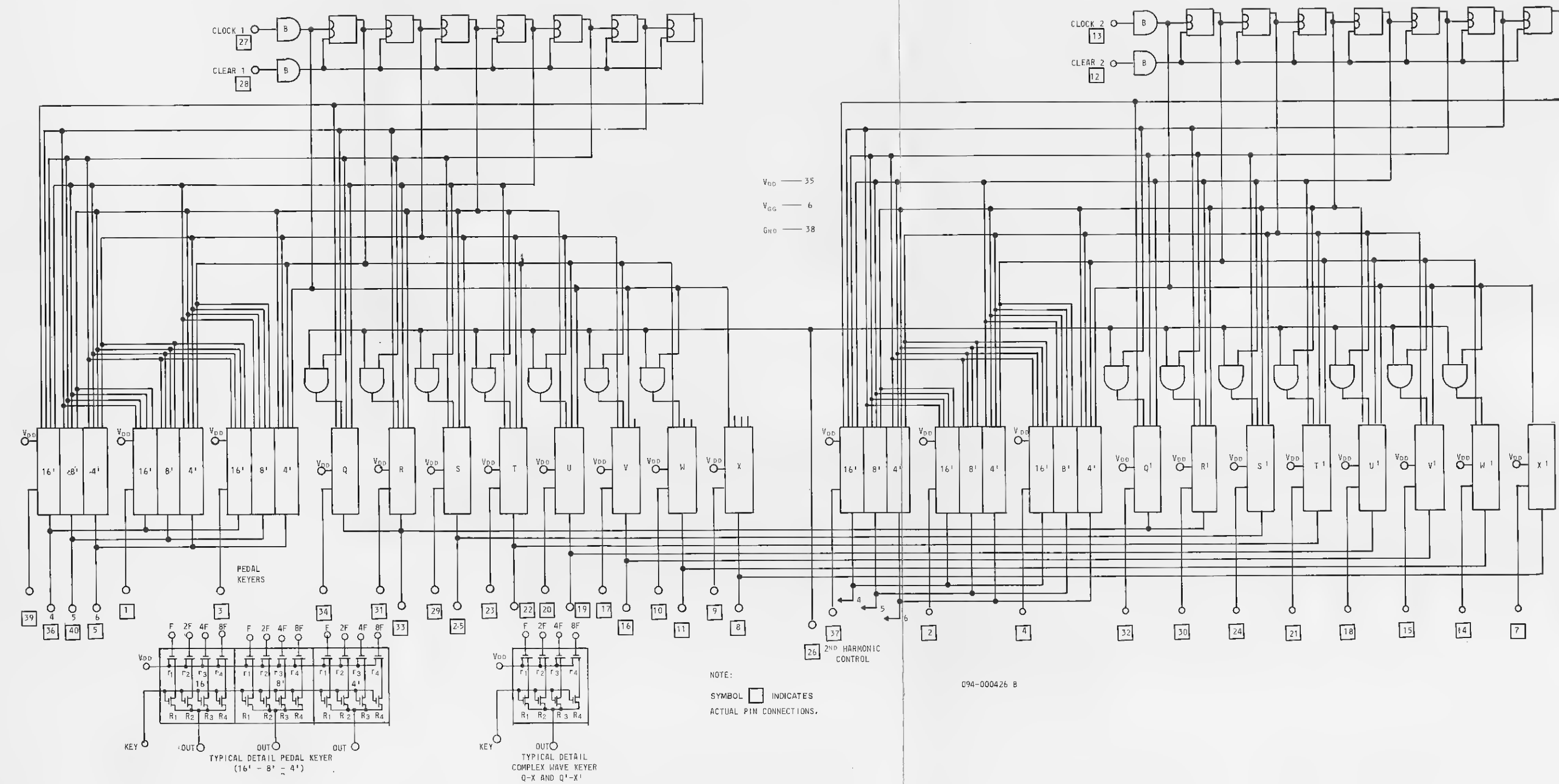
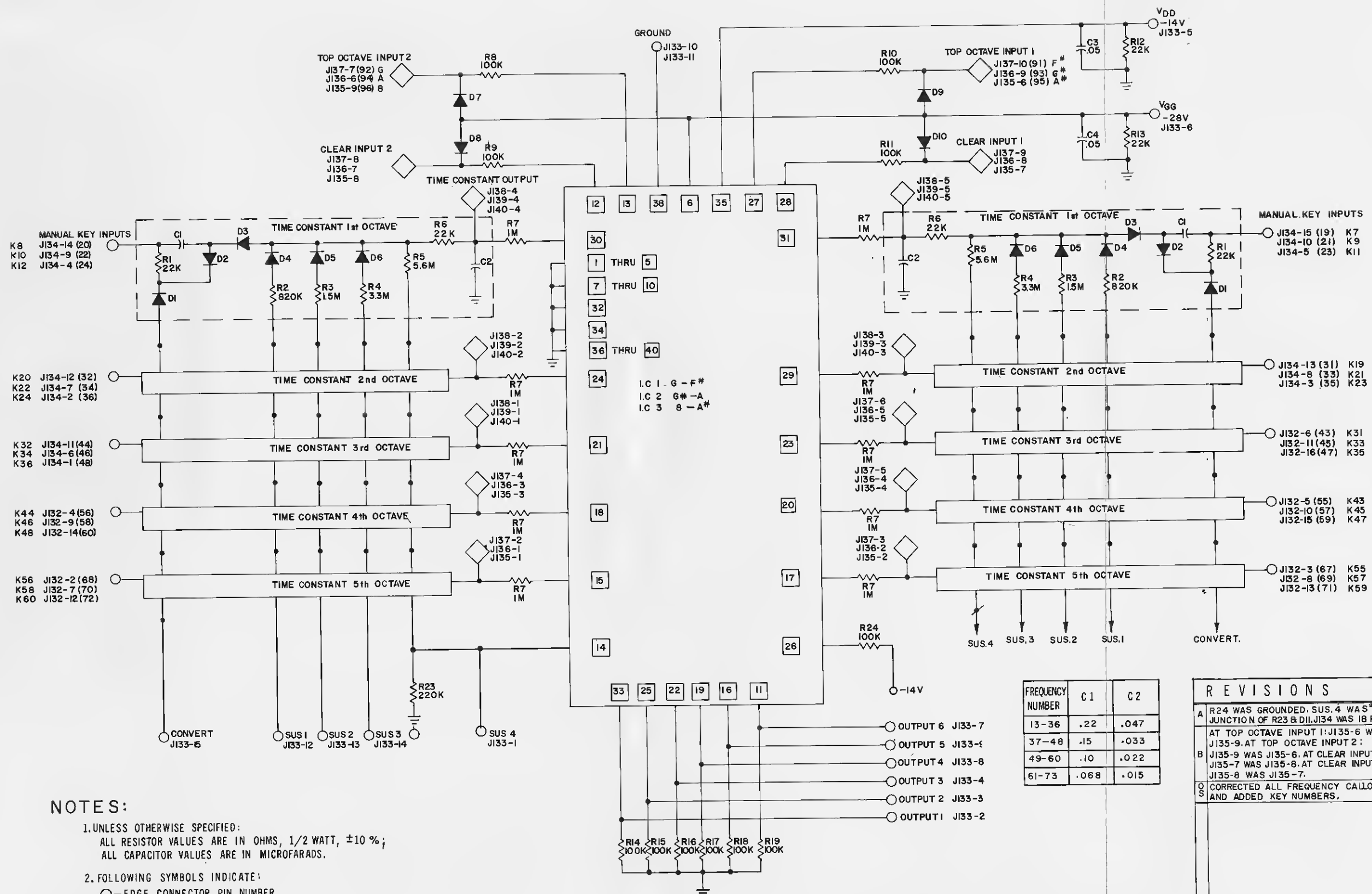


FIGURE 3-17
 I.C. 426, DIVIDER KEYER
 PACKAGE - SCHEMATIC
 (075-000426)



NOTES:

- UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 10\%$;
ALL CAPACITOR VALUES ARE IN MICROFARADS.
- FOLLOWING SYMBOLS INDICATE:
○—EDGE CONNECTOR PIN NUMBER,
□—I.C. PIN NUMBER,
◇—UPRIGHT POST CONNECTOR,
()—FREQUENCY NUMBERS IN PARENTHESIS.

FREQUENCY NUMBER	C1	C2
13-36	.22	.047
37-48	.15	.033
49-60	.10	.022
61-73	.068	.015

REVISIONS	
A	R24 WAS GROUNDED. SUS.4 WAS ³ TO JUNCTION OF R23 & D11. J134 WAS 18 PINS
B	AT TOP OCTAVE INPUT 1: J135-6 WAS J135-9. AT TOP OCTAVE INPUT 2: J135-9 WAS J135-6. AT CLEAR INPUT 1: J135-7 WAS J135-8. AT CLEAR INPUT 2: J135-8 WAS J135-7.
C	CORRECTED ALL FREQUENCY CALLOUTS AND ADDED KEY NUMBERS.

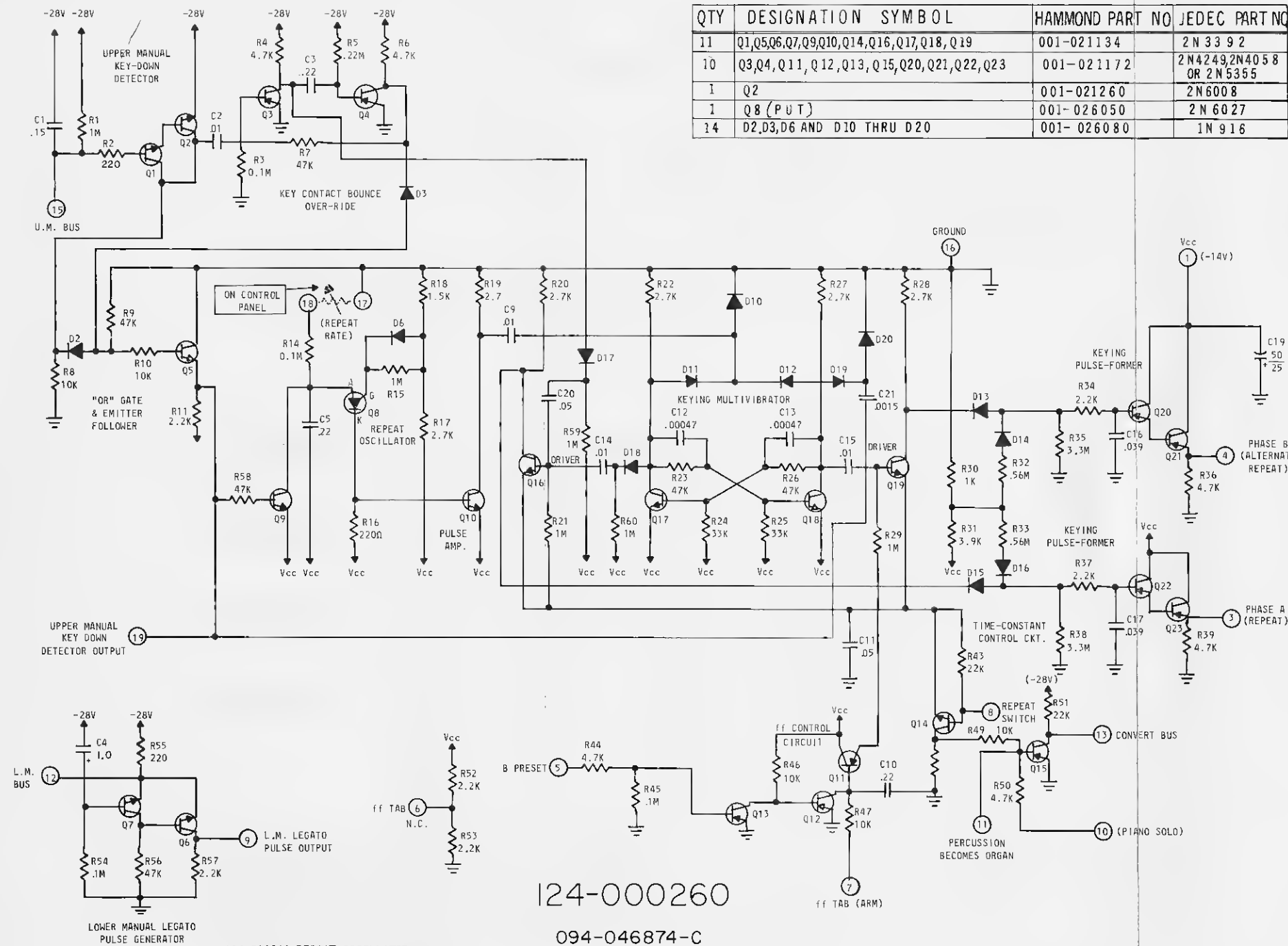
QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
192	D1 THRU D10 (REPEATING)	001-026080	IN 4148
3	I.C. 1, I.C. 2, I.C. 3	075-000426	

124-046769-001

094-045062-001-B

13

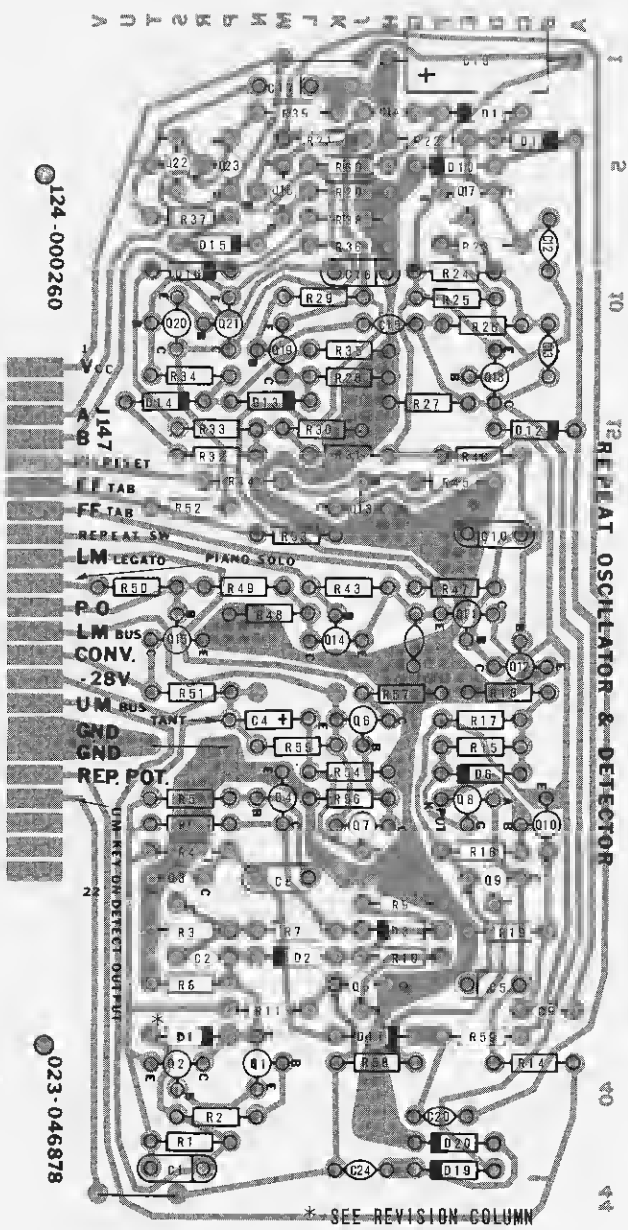
FIGURE 3-18
BRIGHT WAVE PERCUSSION
BOARD - SCHEMATIC
(124-046769-001)



QTY	DESIGNATION	SYMBOL	HAMMOND PART NO	JEDEC PART NO
11	Q1,Q5,Q6,Q7,Q9,Q10,Q14,Q16,Q17,Q18,Q19		001-021134	2N3392
10	Q3,Q4,Q11,Q12,Q13,Q15,Q20,Q21,Q22,Q23		001-021172	2N4249,2N4058 OR 2N5355
1	Q2		001-021260	2N6008
1	Q8 (PUT)		001-026050	2N6027
14	D2,D3,D6 AND D10 THRU D20		001-026080	1N916

REVISIONS	
A	ADDED TERMINAL 19. Q9 WAS 001-021172, DELETED C6, C7 & C8 ADDED C20 & C21, DELETED R12, R13, R40, R41 AND R42. ADDED R58, R59 & R60. DELETED D4, D5, D7, D8 & D9, ADDED D17, D18, D19 & D20. R55 WAS 100 OHMS, C12 AND C13 WERE .0015 MFD.
B	R2 WAS 1K, C4 WAS 4.7 MFD. DELETED D1 & NOTE: "D1=001-024050, EQUIVALENT IN 4001".
C	

- NOTES:
- UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS,
1/2 WATT, $\pm 10\%$;
ALL CAPACITOR VALUES ARE IN MICROFARADS.
 - SYMBOL "3" SIGNIFIES P.W.B. EDGE
CONNECTOR J147 PIN.



The Repeat Oscillator and Detector senses when any upper manual keys have been played and activates circuitry which produces outputs to generate repeat and alternate repeat percussion keying signals. The legato pulse generator for the lower manual is also located on this assembly.

Q1 and Q2 comprise the Upper Manual Key-Down Detector. When no keys are played, Q1 and Q2 are biased off, terminal 15 is near -28V.

If any keys are played, current applied through R1 turns on Q1 and Q2 and their collectors drop to -26.5V, firing monostable multivibrator Q3 and Q4. A negative going pulse from the collector of Q4 enters the "OR" gate at R7, R8, along with negative voltage from the collectors of Q1 and Q2 and is applied to the base of Q5, causing terminal 19 to go to -28V. The period of the monostable multivibrator is adjusted to keep terminal 19 negative during the entire time that manual keys might exhibit "bounce".

REPEAT OSCILLATOR AND KEYERS:

When no keys are being played, Q9 is conducting, keeping C5 discharged. Upon playing any keys, Q9 is biased off, and C5 starts charging through R14 and the repeat rate potentiometer. Q8 does not conduct until C5 charges to a specific voltage, then Q8 turns on and quickly discharges C5. The resulting current flow through R15 produces a pulse which is amplified by Q10 and used to trigger keying bistable multivibrator Q17 and Q18.

The keying multivibrator remains in the state it is in when the last key is released. Subsequent playing of a key causes negative voltage at terminal 19 to be transmitted through D19 to the multivibrator, setting it to the state where Q17 is off with its collector at zero voltage and Q19 is on with its collector at -14V. Should the multivibrator already be in this state, it will remain there. After the initial pulse via D19, each succeeding pulse from Q10 will change the state of the multivibrator. Positive going voltage changes at the collector of Q17 are differentiated and applied to the base of Q16. The negative pulse output at the collector of Q16 charges the timing capacitor C17 through diode D15. If the rest state of the multivibrator is such that the collector of Q17 is positive, no pulse is present to drive Q16 when the first key is played. To insure the availability of a drive pulse, a signal is coupled from the collector of Q3 through D17 and C20 to the base of Q16. (Q3 produces a positive pulse with the first key-down). C17 starts to discharge rapidly through D16 and R33 toward a voltage level determined by voltage divider R30 and R31. As the voltage at C17 becomes more positive than the voltage set by R30 and R31, D16 cuts off and

C17 continues to discharge at a much slower rate through R38. The initial rapid discharge gives uniform duration of notes at fast repeat rates and keeps notes from sounding too short at slow repeat rates. Q22 and Q23 make up a Darlington amplifier with a high input impedance which provides a low output impedance to drive the Synthesis Percussion Gates (124-000261) circuitry in the repeat mode. The positive going output at the collector of Q18 is used in a similar manner, along with Q19, Q20, and Q21 to drive the Synthesis Percussion Gates circuitry for the alternate notes in the Xylophone and Marimba voices.

TIME CONSTANT CONTROL

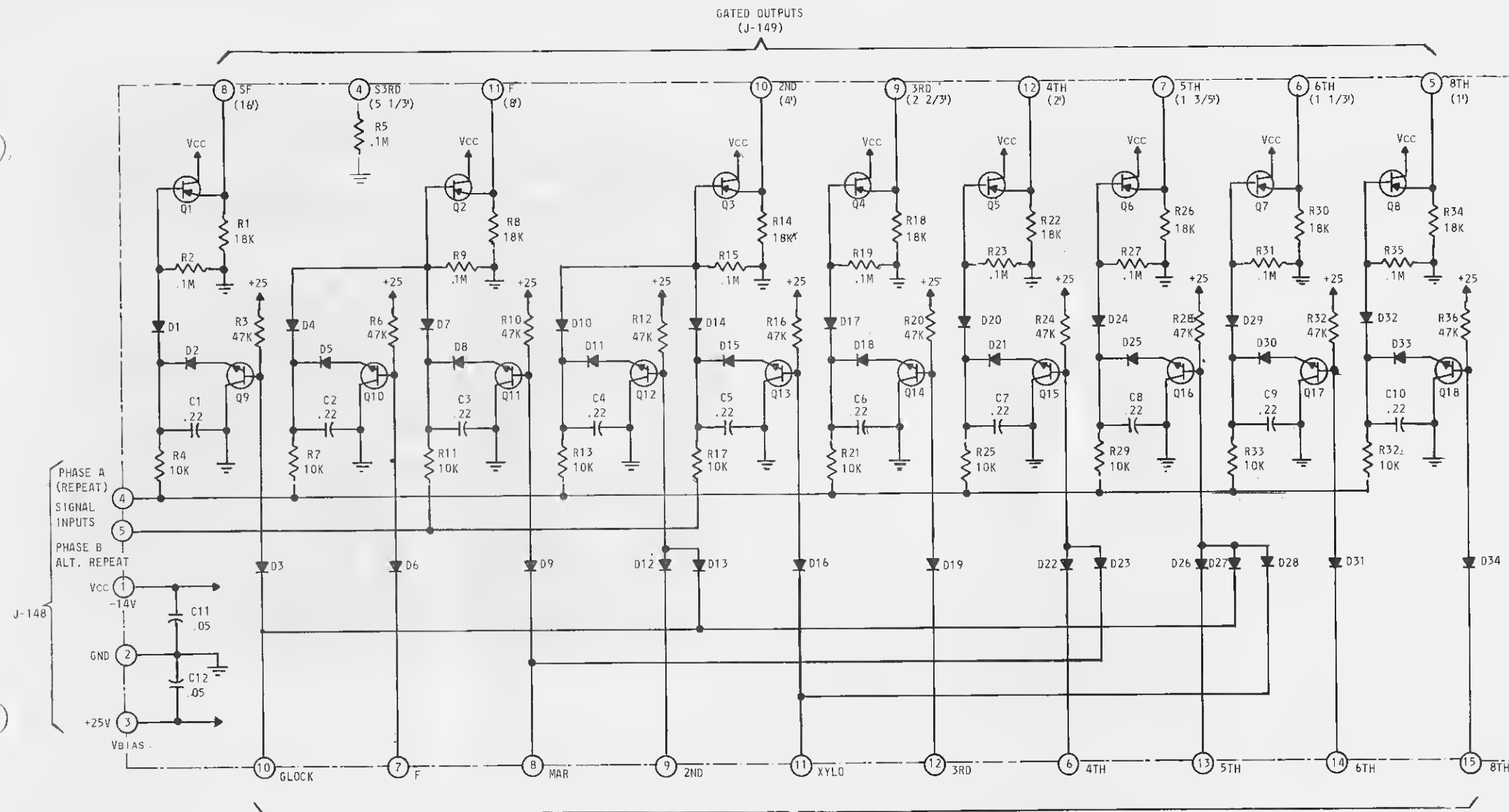
When percussion system is activated, each note has its own percussion keyer. When played, notes die away even if keys are held down. When repeat is used, however, keyers must convert from percussion to normal mode so that as long as keys are down, enough signal is present for the repeat keyer to turn on and off. With the Repeat tab "ON", no connection is made to terminal 8, Q14 and Q15 are off and terminal 13 is at about -28V. This voltage applied to convertible keyers puts them in normal mode. When the Repeat tab is "off", Q14 and Q15 conduct, bringing terminal 13 near zero volts which places convertible keyers in per-

cussion mode. Pressing the Piano tab applies -6V to terminal 10 putting the convertible keyers in percussion mode, overriding the Repeat tab.

Q6 and Q7 make up a monostable multivibrator for use as a lower manual legato detector. Q7 is normally conducting, holding Q6 off. When a lower manual key is played, the voltage across R55 triggers the circuit causing Q6 to generate a negative pulse at terminal 9. This action repeats for each additional key until 15 or 20 are played.

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FIGURE 3-19
REPEAT OSCILLATOR AND
DETECTOR BOARD, SCHEMATIC
LAYOUT AND THEORY
(124-000260)



NOTES:

1. IF OTHERWISE NOT SPECIFIED:

ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 10\%$;
ALL CAPACITOR VALUES ARE IN MICROFARADS.

QTY	DESIGNATION SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
8	Q1 THRU Q8	001-021172	2N 4249
10	Q9 THRU Q18	001-021134	2N 3394
34	D1 THRU D34	001-026080	1N 4148

124-000261

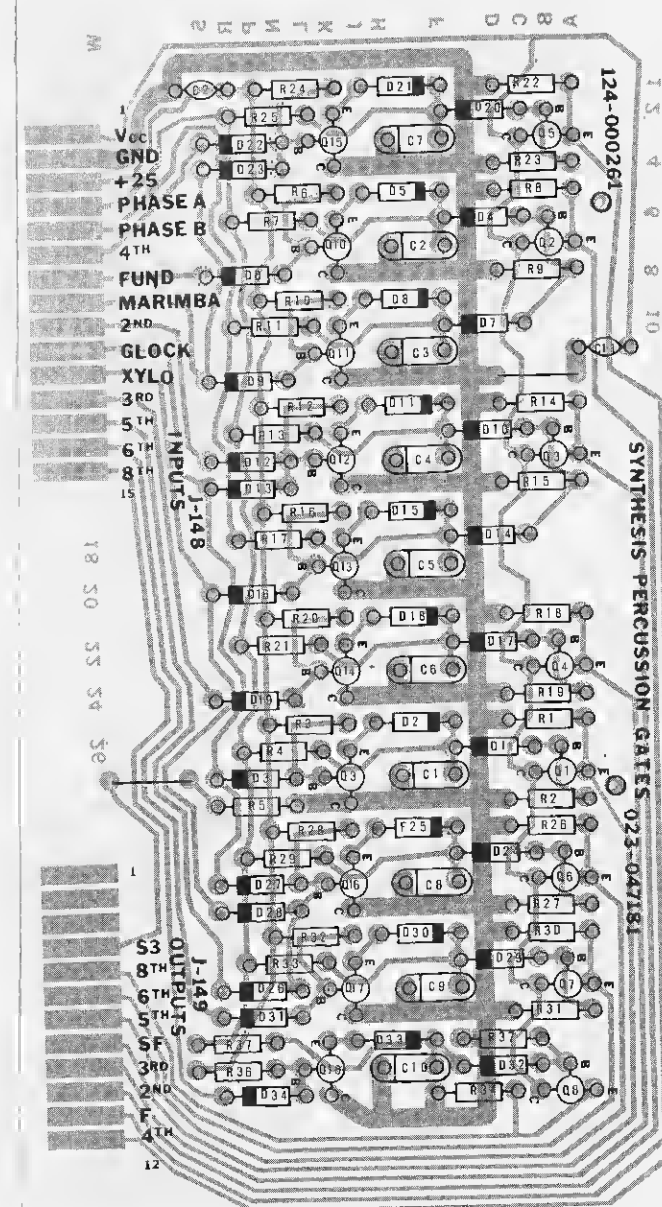
094-046879-0

REVISIONS

SYNTHESIS PERCUSSION GATE BOARD (124-000261)

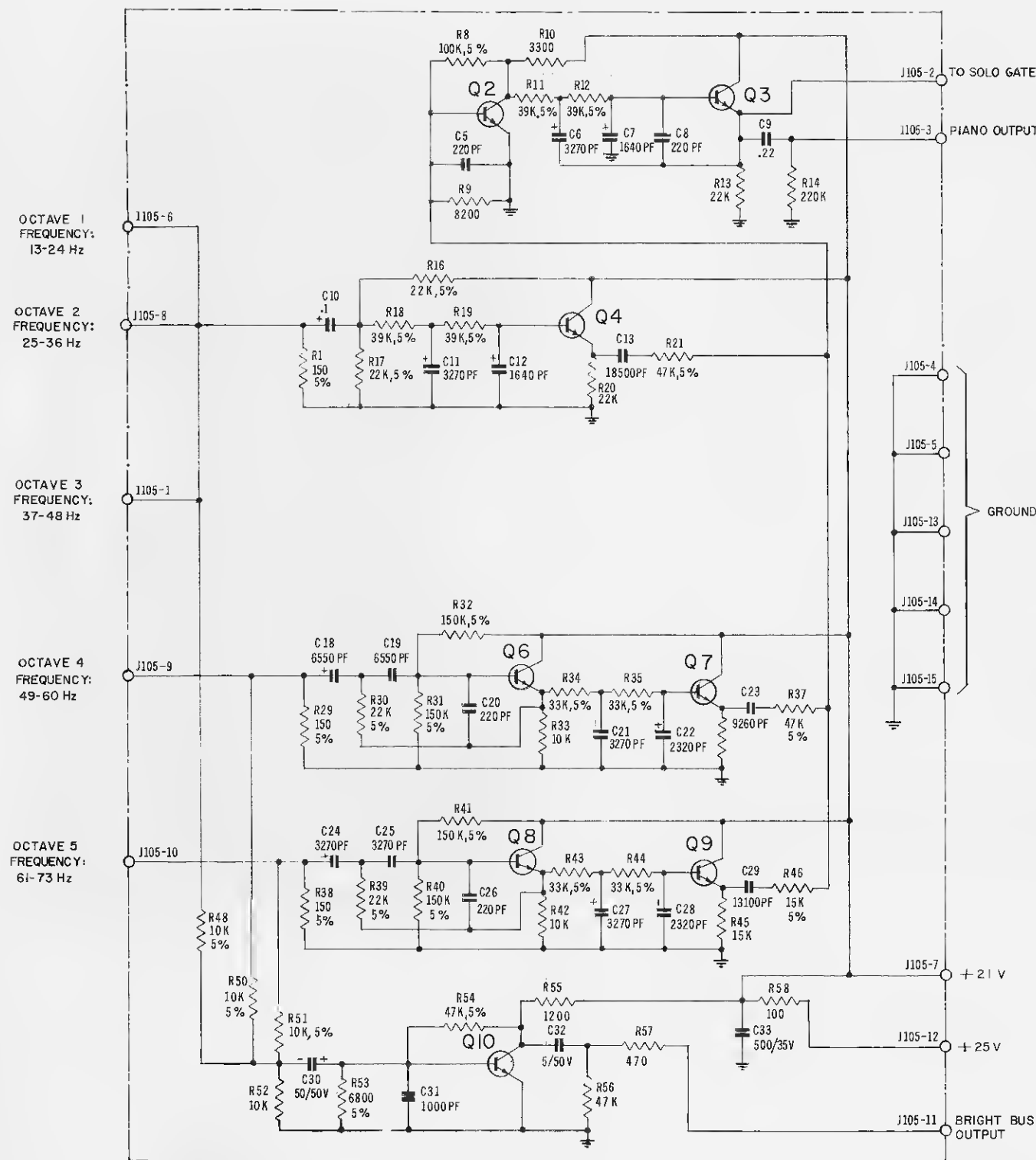
An assembly used for controlling negative going pulse wave-forms between the Repeat Oscillator and Detector board, (124-000223-001) in repeat and alternate repeat modes. In normal keying mode, +25 V is applied to the base terminals of Q9-Q18, placing them in a saturated state and shunting input to ground. When a percussion tab is de-

pressed, -14 V is impressed on terminals J-148-6, 7, 8, 9, 11, 12, 13, 14, and 15, placing Q9-Q18 in a non-conducting state, opening gates and shunting input signals through to appropriate output terminals. Phase A alone admits repeat signal only, at J-148-4. Phase A, plus Phase B, adds alternate repeat signal at J-148-5, for twin-mallet effect on Xylophone and Marimba Voices.



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FIGURE 3-20
SYNTHESIS PERCUSSION
GATE BOARD, SCHEMATIC,
LAYOUT AND THEORY
(124-000261)



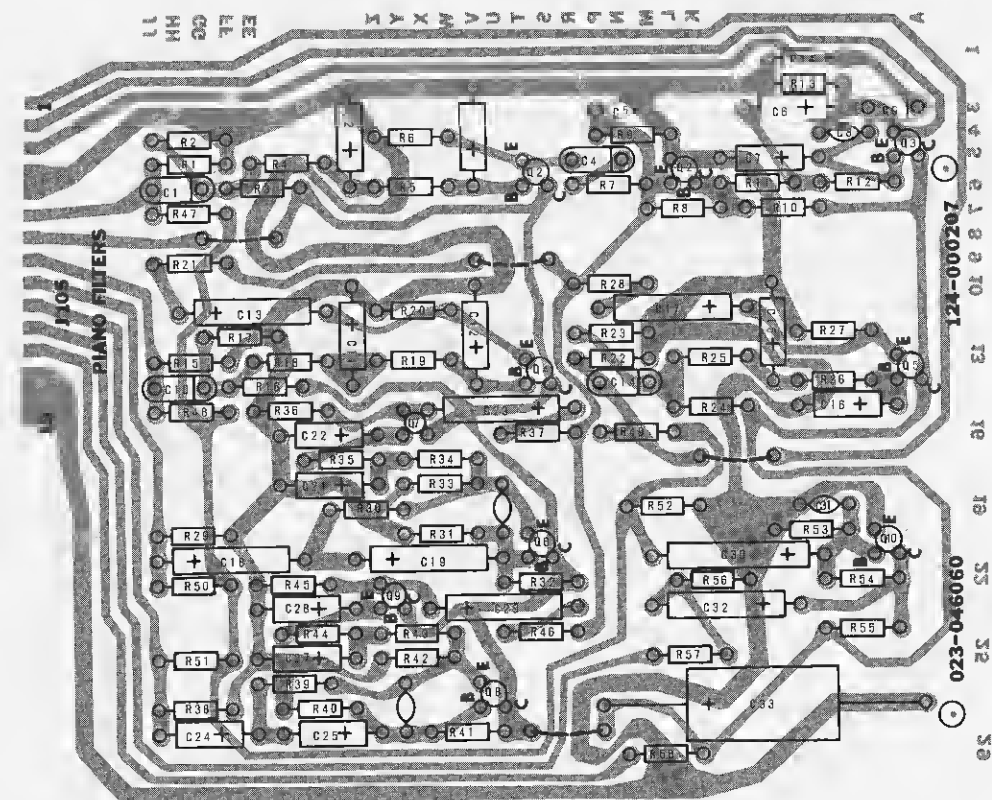
REVISIONS			
A	C30 WAS 25 VOLTS.		
B	DELETED OCTAVE 1 COMPONENTS: R2 THRU R7 AND C1 THRU C4, ALSO Q1-001-021135. R15 DELETED IN OCTAVE 2 CIRCUITRY. DELETED OCTAVE 3 CIRCUITRY: R22 THRU R28, C14 THRU C17, R47, R49 AND Q5-001- 021135.		

QTY	DESIGNATION	SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
7	Q2, Q3, Q4, Q6, Q7, Q8, Q9		001-021260	2N 5826
1	Q10		001-021133	2N 3394

NOTES:

- UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 10\%$;
ALL CAPACITOR VALUES ARE IN MICROFARADS.

124-000207
094-046069-B



124-000207 PIANO FILTER BOARD

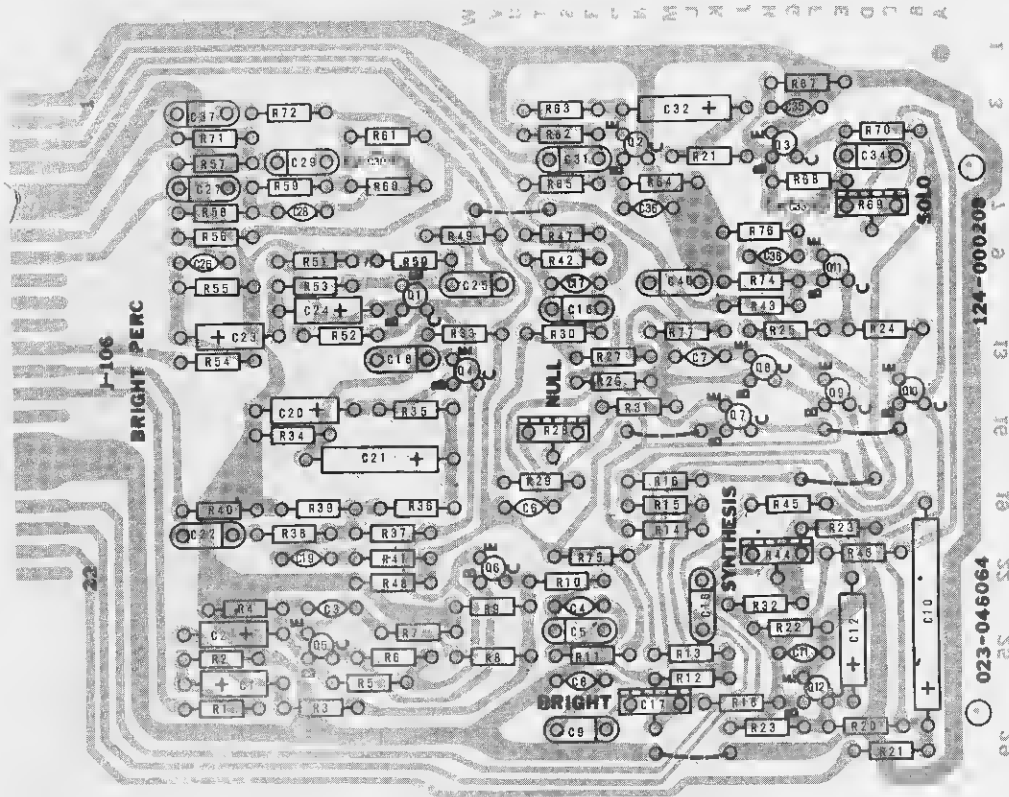
At J105, on the assembly, three filter groups are fed by a five octave input with the three lowest octaves tied together and applied to a single filter section. IC keyers develop a signal of 150-200 mv P/P at the 150 ohm input load resistors. Active low pass 2 pole filter sections are used with an extra high pass filter stage in the two highest octaves providing a sharp low frequency cutoff slope to reduce keying thump to an acceptable level. The lowest octave uses input and output coupling capacitors to control low frequency cutoff. The three filter groups are mixed into summing amplifier Q2 and passed through another active low pass 2 pole filter section, where Q3 provides a low impedance output for the Piano Solo input on the Bright Percussion Filter Board assembly. (124-000208)

Another function of the Piano Filter Board is, supplying an output for the low impedance filters on the Bright Percussion Filter PWB (Pizzicato 1, 2, Piano, Harpsichord, Banjo). The five octave stair-step wave frequencies are resistively mixed into bright summing amp Q10, (bypassing the piano filters) which provides a low impedance output at Pin 11. A resistor in series with the output supplies automatic robbing so that one voice can be loud enough without having several voices at an unreasonable level simultaneously.

NOTE: EARLIER VERSIONS OF THE 124-000207 BOARD CONTAINED FIVE FILTER GROUPS FOR THE INPUTS INSTEAD OF THREE, BUT WERE SIMILAR TO THE CURRENT DESIGN IN ALL OTHER ASPECTS.

FIGURE 3-21
PIANO FILTER BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-000207)

16



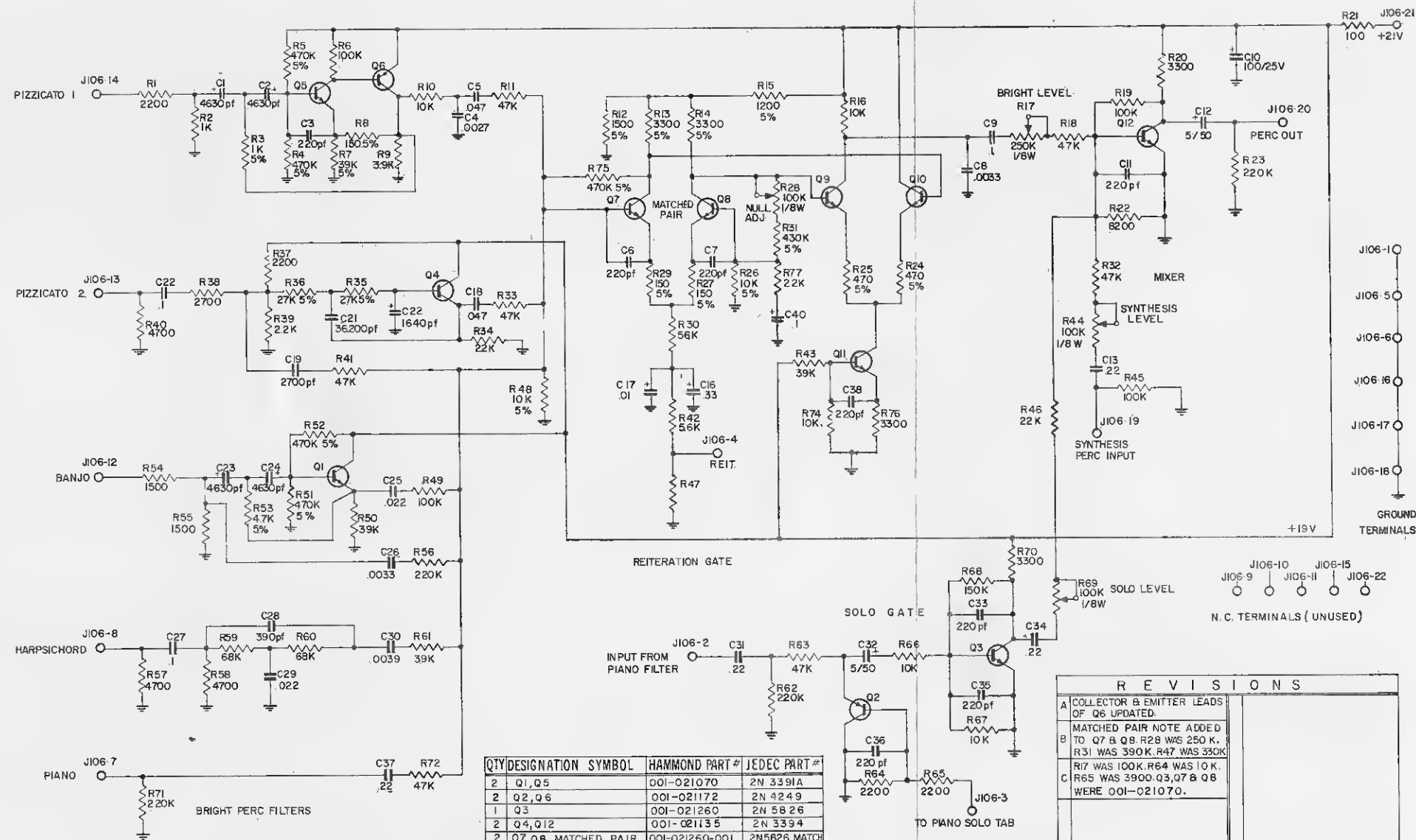
124-000208 BRIGHT PERCUSSION FILTER BOARD

Signals enter the board at J106 and pass thru three active filters; Pizzicato 1, 2 and Banjo, a passive filter is used for Harpsichord. The filter outputs are mixed with a Piano voice input from the 124-000207 board into the repeat gate composed of Q7, Q8, Q9 and Q10, a two stage differential amplifier that has the emitter current of its first stage (Q7-Q8) supplied by a sawtooth repeat signal from J147 on the Repeat Oscillator and Detector board (124-000260) when repeat is on, or a D.C. level when repeat is off. There is a null adjustment (R28) to minimize repeat thump, requiring a matched pair of transistors (001-021260-001) in the first stage to achieve the best null. Tab action changes the level of D.C. or sawtooth signal to the repeat gate, providing Fortissimo as desired. When Piano Solo is used, repeat signal and control voltage are removed, turning off Bright Percussion. On/Off gating at Q2 and amplification at Q3 are provided for Piano Solo whose input at pin 2 bypasses the repeat gate. Synthesis percussion signals enter this board at pin 19 and are summed with repeated bright percussion and Piano Solo at output amplifier, Q12.

Gain controls are provided for these signals at R69 (Solo), R44 (Synthesis), and R17 (Bright). The required +21V comes from the Piano Filter Board (124-000207) which has a decoupling filter for the supply.

NOTE: Earlier versions of the 124-000208 Bright Percussion board have matched 001-21270's in the repeat gate. (Q7 and Q8).

NOTES:
1. UNLESS OTHERWISE SPECIFIED:
RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 10\%$;
CAPACITOR VALUES ARE IN MICROFARADS,
WITH VOLTAGES SHOWN FOR ELECTROLYTICS ONLY.
CAPACITOR TOLERANCE - MYLAR & CERAMIC: $\pm 10\%$, POLYSTYRENE: $\pm 2.5\%$.

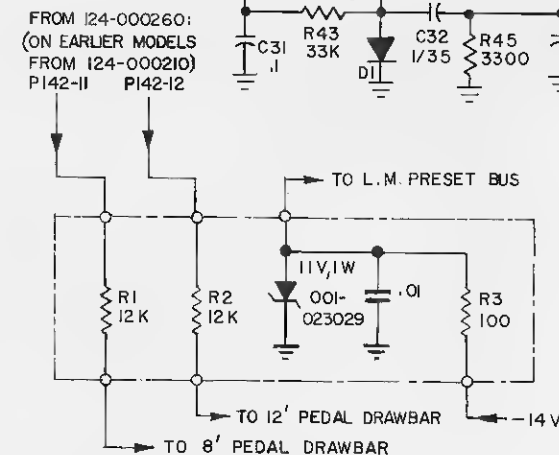
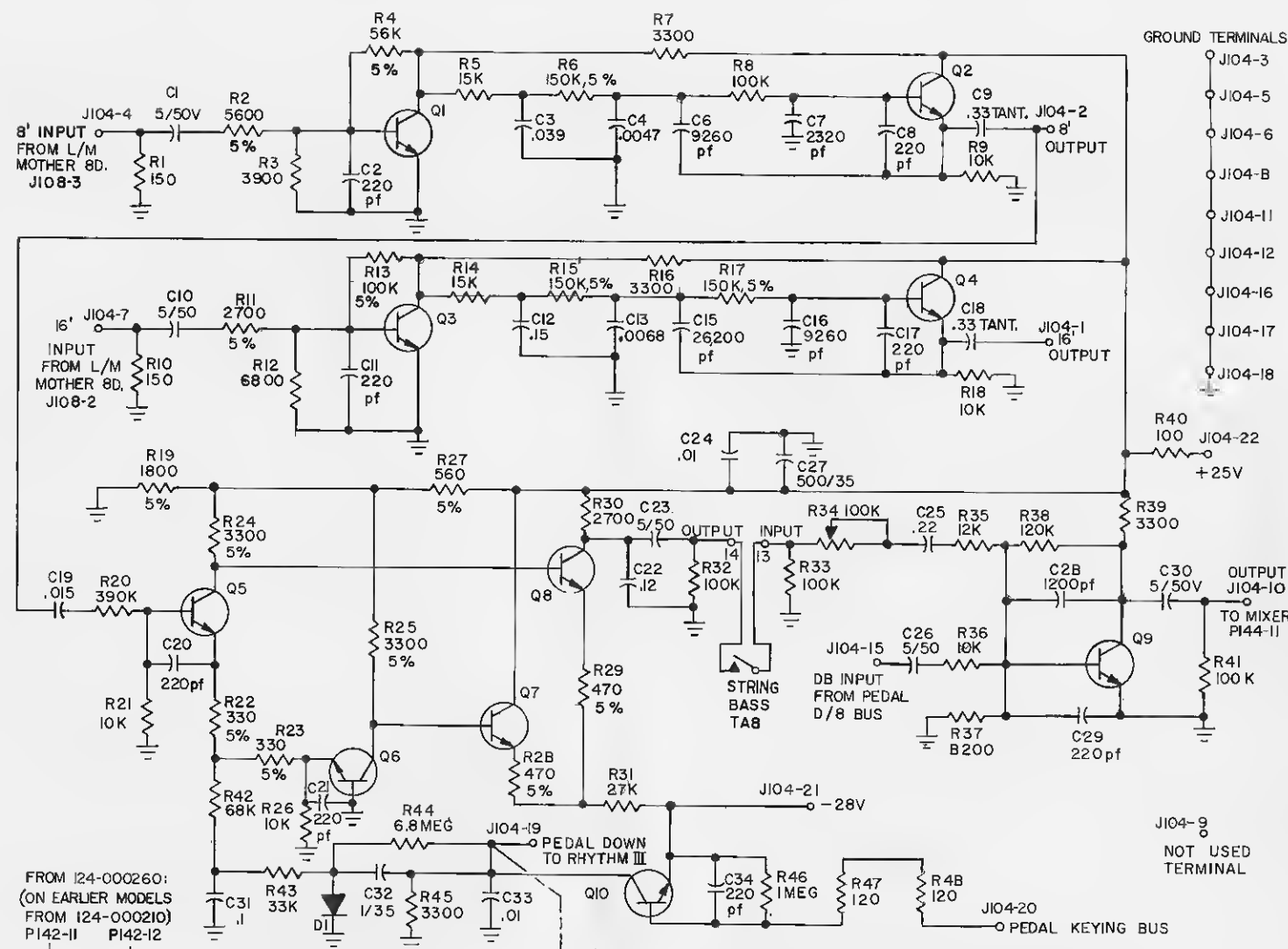


124-000208
094-046070-C

R E V I S I O N S	
A	COLLECTOR & EMITTER LEADS OF Q6 UPDATED.
B	TO Q7 & Q8. R28 WAS 250 K. R31 WAS 390 K. R47 WAS 330K
C	R17 WAS 100K. R64 WAS 10 K. R65 WAS 390K. Q3, Q7 & Q8 WERE 001-021070.

17

FIGURE 3-22
BRIGHT PERCUSSION FILTER
BOARD-SCHEMATIC, LAYOUT
AND THEORY
(124-000208)



PEDAL DRAWBARS TERMINAL STRIP
063-046759

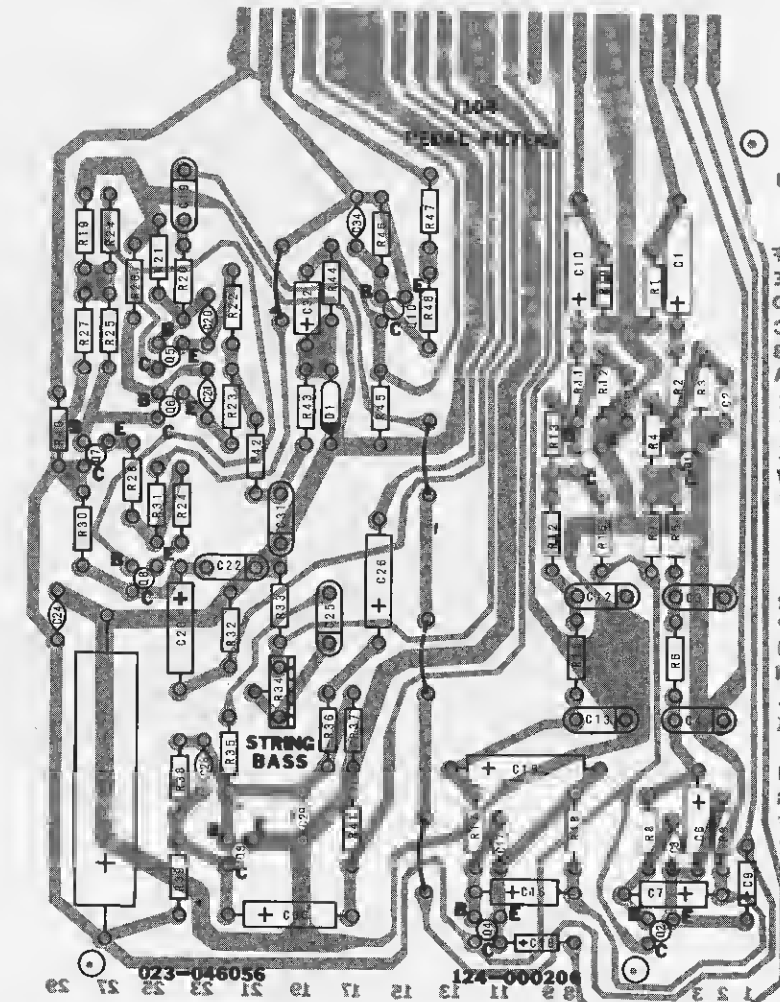
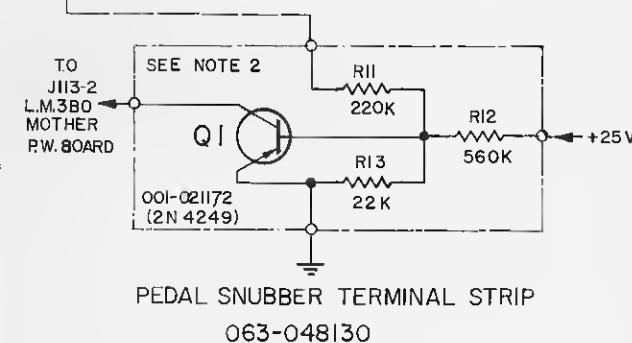
124-000206
094-046068-D

QTY	DESIGNATION	SYMBOL	HAMMOND PART	JEDEC PART
5	Q1, Q2, Q3, Q4, Q9		001-021135	2N 3394
2	Q5, Q6		001-021070	2N 3391A
2	Q7, Q8		001-021133	2N 3394
1	Q10		001-021260	2N 5826
1	D1		001-026080	1N 4148

REVISIONS	
A	C12 WAS .0B2, C15 WAS 1B, 500 pf. C18 WAS .22, R15 WAS 100K, C10 WAS 1/35 V.
B	R1 & R10 WERE 100Ω. R35 WAS 15 K.
C	C33, .01MFD, DELETED.
D	C1 WAS 1/35 V, C5, .0047, DELETED. C9 WAS .47 RADIAL. C10 WAS 4.7/10 V, C13 WAS .0047 CERAMIC. C14, .01, DELETED. C18 WAS .33 RADIAL. C33, .01, DELETED. R14 WAS 10 K, R15 WAS 120 K, R17 WAS 100 K, R47 & R48 ADDED. B' MUTE (8 PIN 3) DELETED. 16' MUTE (8 PIN 8) DELETED. PART NO. ADDED TO Q9. ADDED 3 & B GROUND PINS. UNUSED TERMINAL 9 SHOWN. R5 WAS 10 K, R6 WAS 150 K, R45 WAS 15 K, C4 WAS .0022 MFD. CERAMIC.
QS	ADDED PEDAL DRAWBARS & PEDAL SNUBBER CIRCUITS.

NOTES:

- IF OTHERWISE NOT SPECIFIED:
RESISTOR VALUES ARE IN OHMS,
1/2 WATT, ± 10 % ;
CAPACITOR VALUES ARE IN MICROFARADS.
- PEDAL SNUBBER CIRCUIT:
A) NOT USED IN EARLY MODELS.
B) INSTALLED IN LATER MODELS, AS SHOWN.
C) TRANSFERRED TO 124-000360 P.W. BOARD IN PRESENT MODELS.



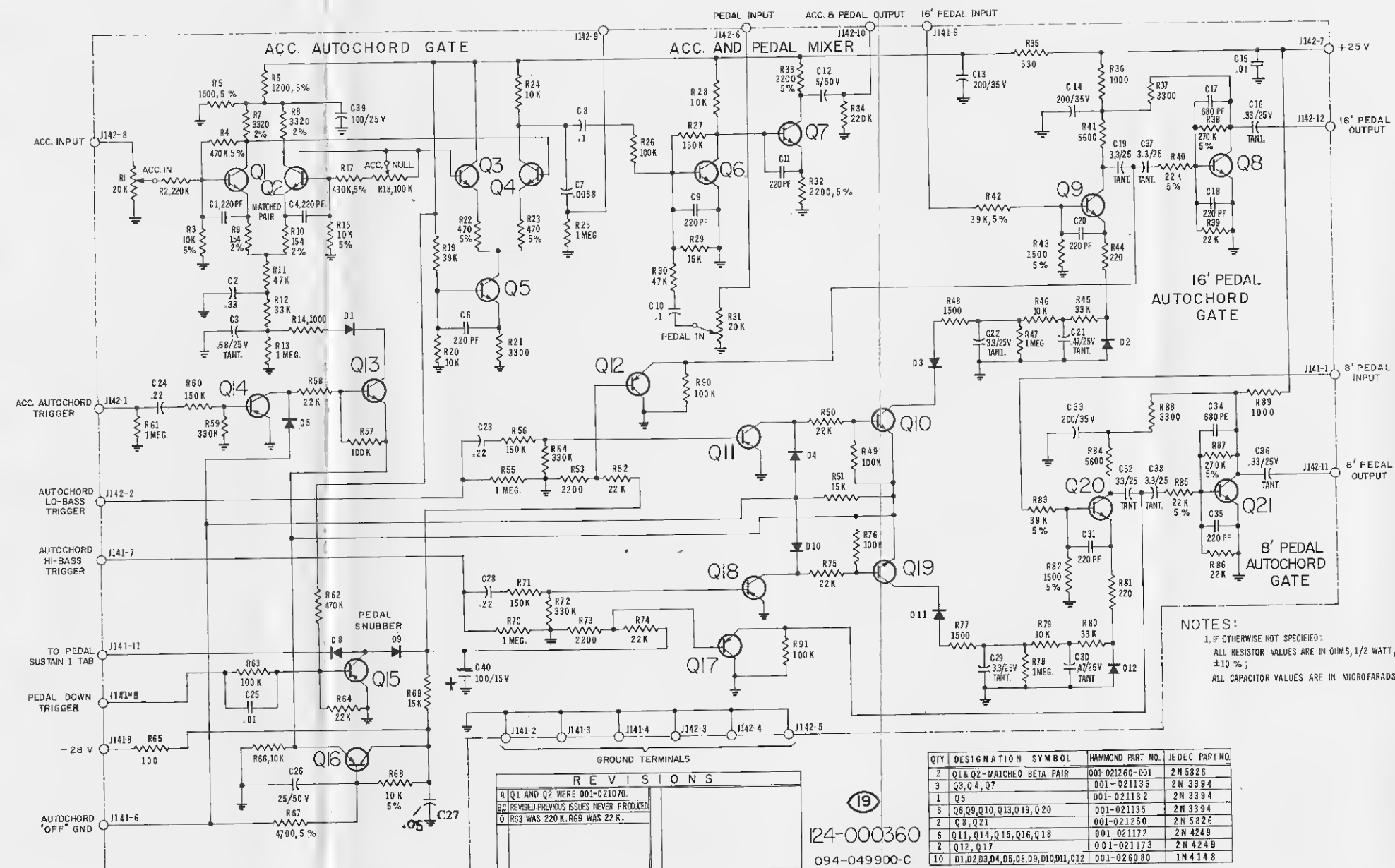
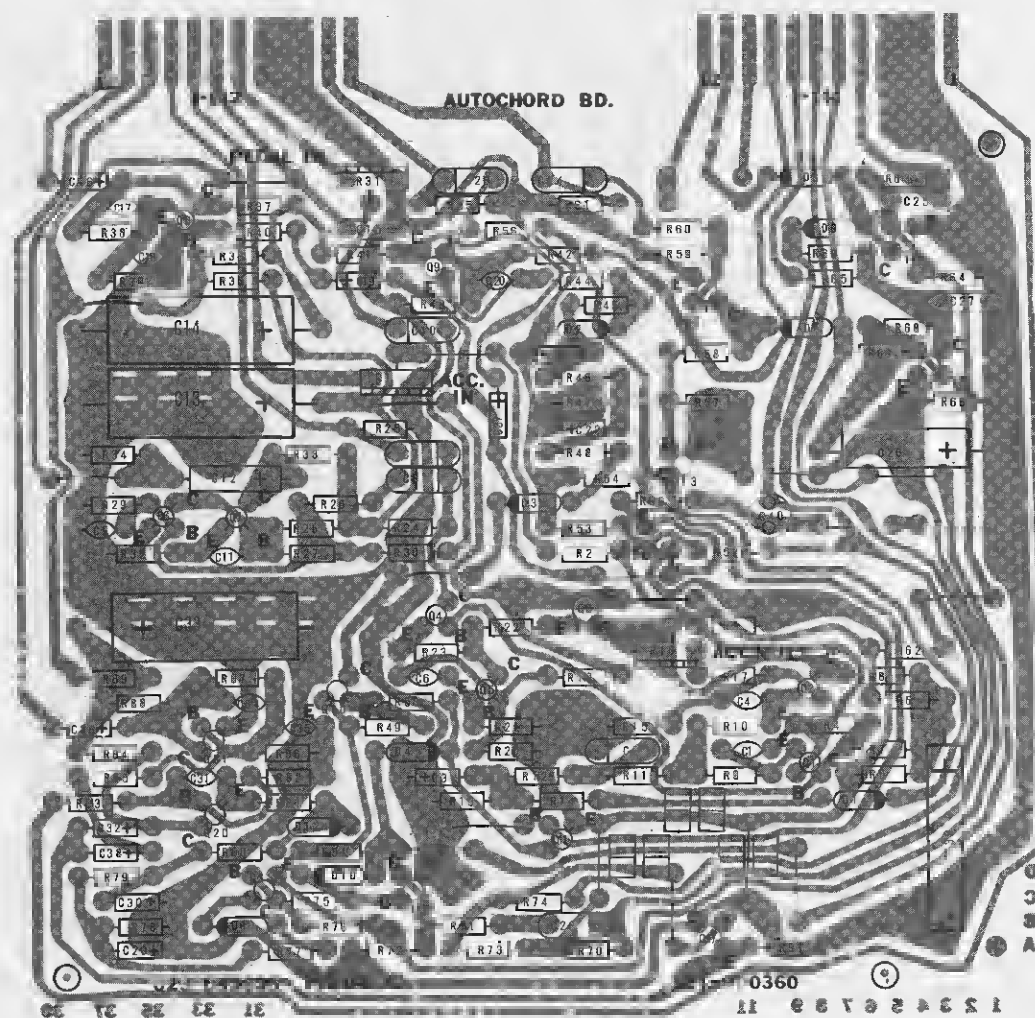
124-000206 PEDAL FILTER BOARD

Pedal output signals (Square-Wave) from J111 and J112 on the Lower Manual Synthesis Mother Board, (124-000223) enter the 16' and 8' active low pass filter circuits at J104, pins 7 and 4, of the Pedal Filter Board where sine-wave pedal tones are produced. 8' String Bass gating and a pedal down detector are also provided. The String Bass gate is a two stage differential amplifier, (Q5-Q6 and Q7-Q8) which operates in a touch response percussion mode, but does not decay to inaudibility. Touch response keying information for the String Bass circuit and follow-the-player rhythm is provided by the pedal down detector, which connects to the pedal keying bus. R47 and R48 prevent Q10 in pedal down detector from failing when pedal keying bus is shorted to ground. Pedal tones go to associated terminal strip and to either J141, pins 1 and 9 on the auto-accompaniment board (124-000360) or to pedal tonebars thru external 12K resistors, then back to Q9 on pedal filter board for amplification and mixing with String Bass.

CAUTION NOTE: Early models of the 124-000206 board do not have protective resistors, therefore pedal keying bus must not be shorted to ground.

18

FIGURE 3-23
PEDAL FILTER BOARD AND
SNUBBER TERMINAL STRIP
SCHEMATIC, LAYOUT AND THEORY
(124-000206)



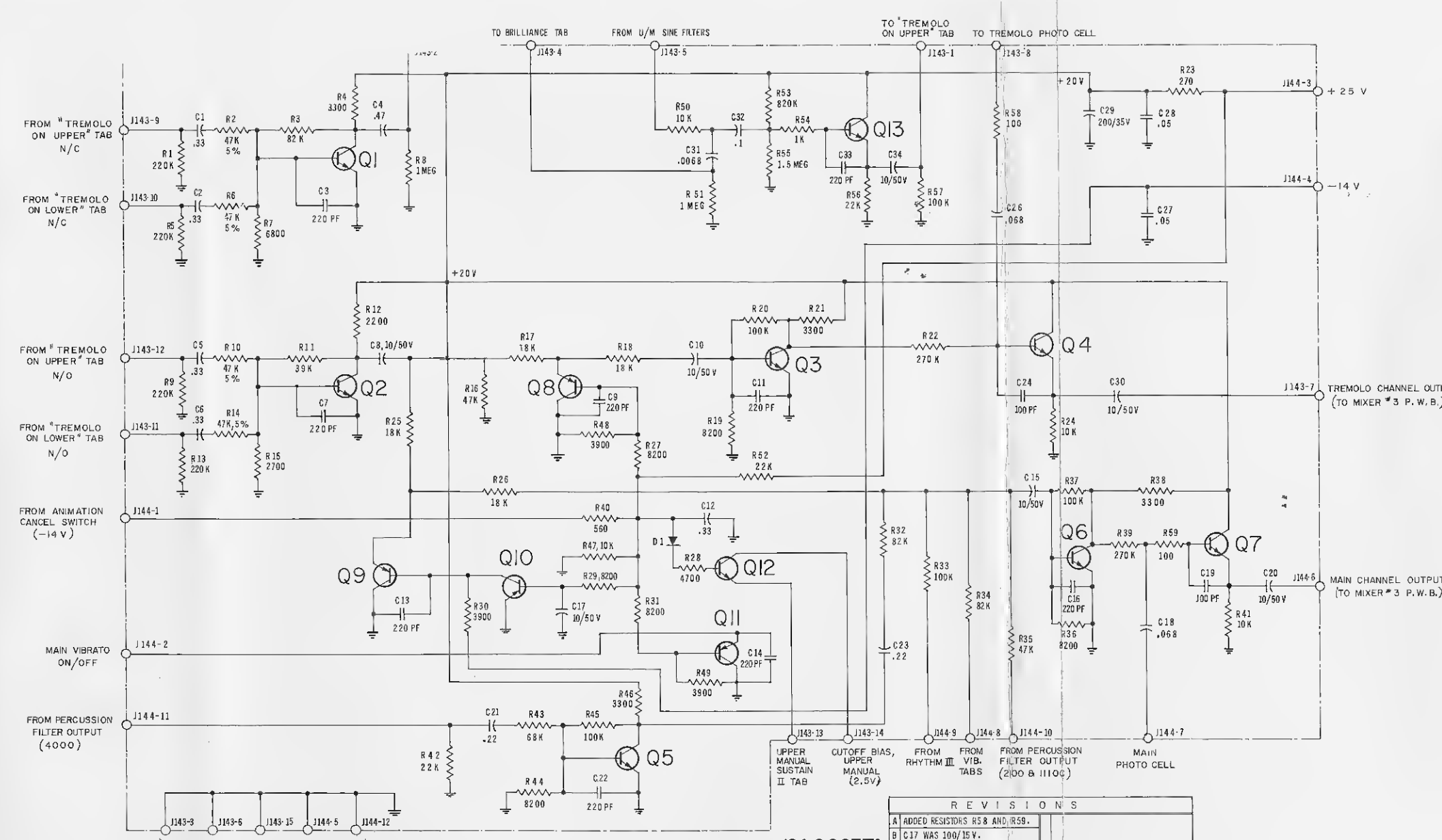
124-000360 AUTO-ACCOMPANIMENT BOARD

Triggered by pulses from the Timing Generator Board, (124-000214) this assembly provides gating for lower manual and pedal voices when automatic accompaniment and chording is desired. The lower manual gate has a fixed time constant provided by a two stage differential amplifier with the emitter current of the first stage supplied by pulses from the rhythm unit when "on" and turns off when supplied with a D.C. level. A brilliance control is provided at the output which grounds J-142-9 to roll off response 3 DB at 2000 HZ when "off". In the "on" position, ground is removed, making high frequencies apparent. Gain is unity with no phase inversion and a null adjustment is provided to reduce thump. Pedal gates are single transistor keyers and pedal

down audio gating is used to prevent thump when no signal is present. A pedal snubber circuit is provided to allow channelling of pedal and lower manual signals into the tremolo unit. Pedal gain is controlled by potentiometer R31.

NOTE: On early models of the Concorde, the Auto-accompaniment functions are carried out on the Mixer #1 board, (124-000210) which is similar to the current assembly but has an additional differential gate and null adjustment (for the pedals) and uses diodes to kill sustain on lower manual and pedals. Pedal snubber circuit and pedal gain pot are not provided on this board.

FIGURE 3-24
 AUTO CHORD BOARD
 SCHEMATIC, LAYOUT AND THEORY
 (124-000360)



NOTES:
 1. IF OTHERWISE NOT SPECIFIED:
 ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, ±10%;
 ALL CAPACITOR VALUES ARE IN MICROFARADS.

QTY	DESIGNATION	SYMBOL	HAMMOND PART #	JEDEC PART #
9	Q1 THRU Q7 & Q12, Q13		001-021135	2N3394
4	Q8, Q9, Q10, Q11		001-021172	2N4249
1	D1		001-026080	1N4148

124-000374

094-050409-B

20

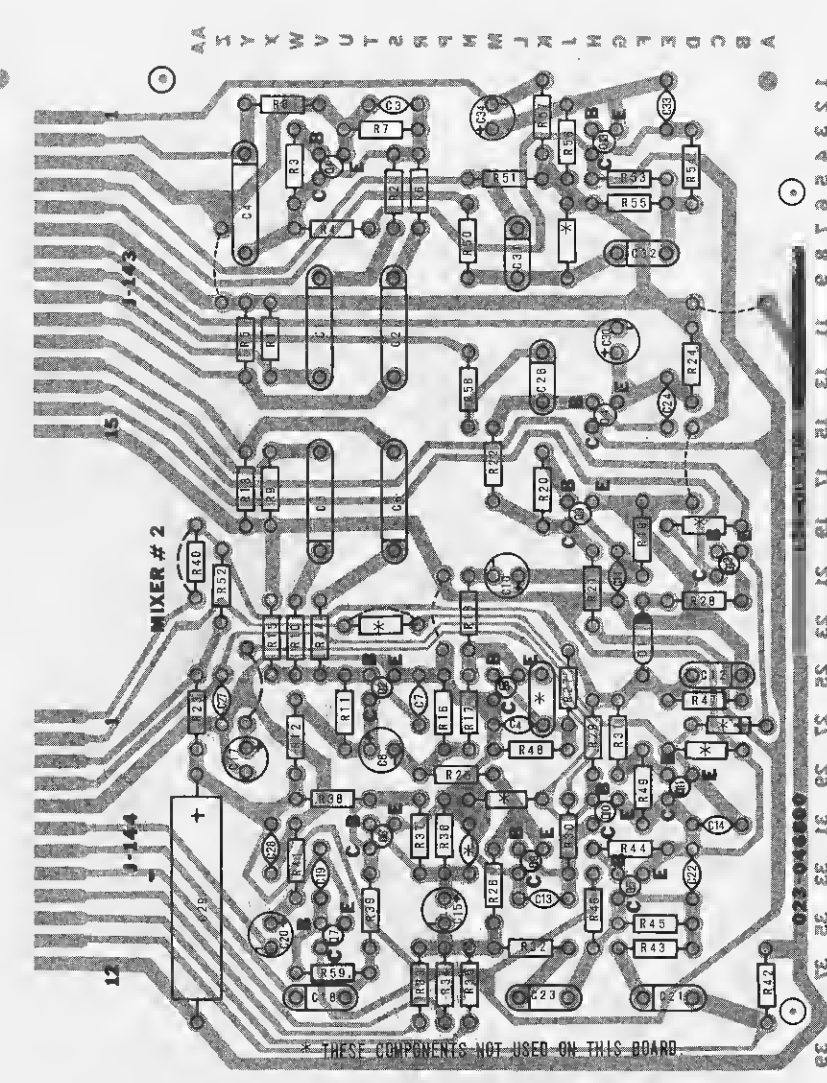
REVISIONS	
A	ADDED RESISTORS R58 AND R59.
B	C17 WAS 100/15V.

124-000374 MIXER #2 BOARD

This assembly is used to provide animation cancel circuitry, swell pedal contouring for main and tremolo channels, mixing of upper and lower manual signals into After Vibrato or Acoustic Tremolo and mixing of After Vibrato output, percussion, rhythm low frequencies and pedal signals into the main channel. A brilliance control is included for the upper manual. When brilliance control is on, a ground is removed from the circuit allowing upper manual response to be flat. Turning off the brilliance control connects circuit to ground and response rolls off 3 DB/octave from 2000 HZ. The control has a built-in 2 DB loss, which enables the lower manual brilliance control on the Auto-Accompaniment Board (124-000360) to be effective. The animation cancel circuitry is

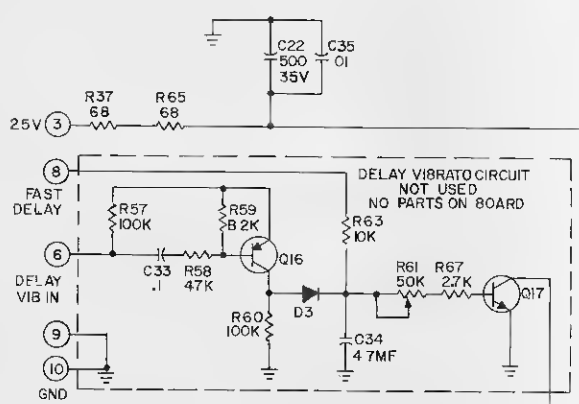
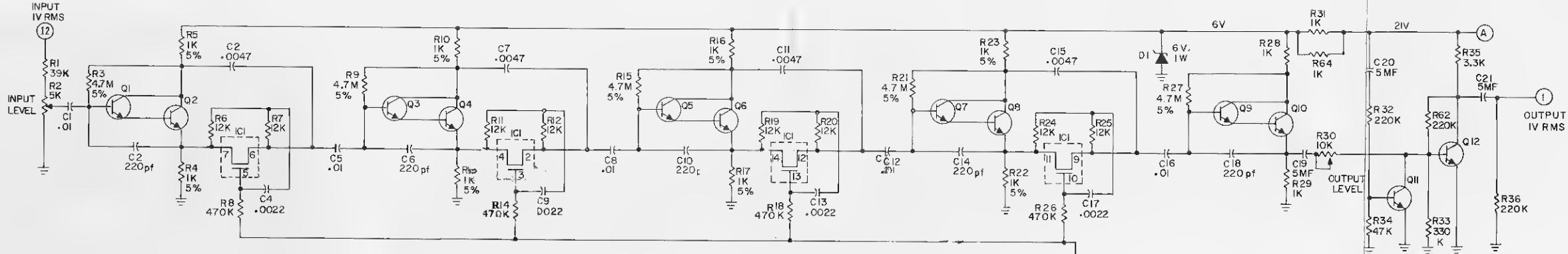
an electronic single pole, double throw switch with "pop" suppression, activated by -28V applied thru the expression pedal left side switch. Closing the switch removes all signals in the tremolo channel and routes them to the main channel. In parallel with the "Sustain to Foot Switch" tab, an electronic switch opens the upper manual 380 time constant circuit, converting the keys to long sustain mode. Another switch grounds the After Vibrato On/Off control line, removing vibrato.

NOTE: Previous Concorde models came with a 124-000211 Mixer #2 Board, a device similar to the current design, but without "pop" suppression and incorporating a pedal control pot which is now on the Auto-Accompaniment assembly. (124-000360).



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FIGURE 3-25
 MIXER BOARD #2
 SCHEMATIC, LAYOUT AND THEORY
 (124-000374)



NOTES:
 1. UNLESS OTHERWISE SPECIFIED:
 ALL RESISTORS ARE IN OHMS $\pm 10\%$ 1/2 WATT;
 ALL CAPACITORS ARE IN MICROFARADS.
 2. CIRCLED NUMBERS REFER TO TERMINALS ON
 PRINTED WIRING BOARD.
 3. IC1 IS 4 MATCHED P CHANNEL FET.

QTY	DESIGNATION SYMBOL	HAMMOND PART NUMBER	JEDEC PART NUMBER
11	Q1 THRU Q10 AND Q12	001-021260	2N 5826
5	Q11, Q13, Q14, Q15, Q17	001-021133	2N 3394
1	Q16	001-021170	2N 4249
2	D1, D2	001-023033	1N 1766
1	D3	001-026030	1N 461A

REVISIONS	
A	001-023033 TRANSISTORS WERE 001-23033.
B	ADDED NOTES 1 AND 2.
C	TERMINAL NOS. WERE FROM 1 TO 10.
D	Q1 THRU Q8 AND Q12 WERE 001-021135.

124-000213
 094-046349-D

124-000213 AFTER VIBRATO BOARD

Two After Vibrato Printed Wiring Boards are used, one each for the main and reverb channels, as they are similar in function, only the main channel system will be described. The desired vibrato rate is 4.8 to 6.8 HZ.

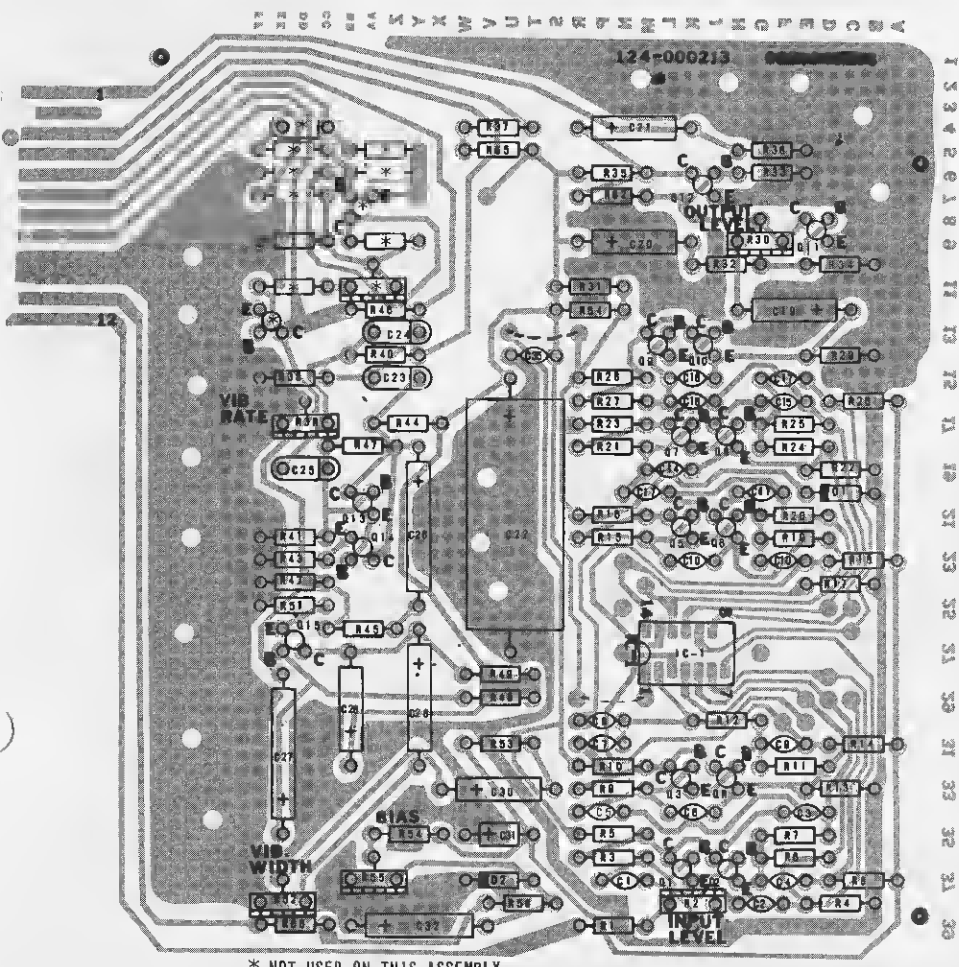
These are the sub-circuits included in each After Vibrato System:

1. Vibrato rate oscillator with on, off, rate and amplitude controls.
2. Adjustable regulated bias supply and regulated reference supply voltages.
3. Four cascaded, variable phase shift circuits.
4. Output amplifier.
5. Output time delay.

From Q1 of the vibrato mixer, (on Mixer #2 Board, 124-000374) signals enter a potentiometer voltage divider, (J151) providing a maximum level at the emitter of the first phase splitter of .35V R.M.S. The Darlington phase splitter develops signals 180° out of phase at the collector and emitter of Q2. The signals are combined in the following networks of the collector capacitor, C3 and the FET, a section of IC-1, which is used as a variable resistor. The source-to-drain resistance of the FET is controlled by a DC voltage appearing between the source and gate terminals. When the gate is slightly negative to the source, the drain-to-source resistance is low. (100-600 ohms). As the gate is made more negative to the source, the drain-to-source resistance rapidly increases to many meg ohms. This high resistance is limited to 24K ohms by R6 and R7 in series across source and drain of the FET. By applying DC bias to the gate and super imposing a vibrato rate sine-wave on the bias, the source-to-drain path appears as a pure

resistance, varying a pre-determined rate from 100 to 24K ohms, in a sine-wave configuration. Feedback at the FET gate is supplied from the junction of R6 and R7 through C4 to cancel phase distortion of the FET. The signal at the junction of C3 and the drain of the FET varies in phase, due to the reactance of the capacitor, in conjunction with the varying resistance of the FET.

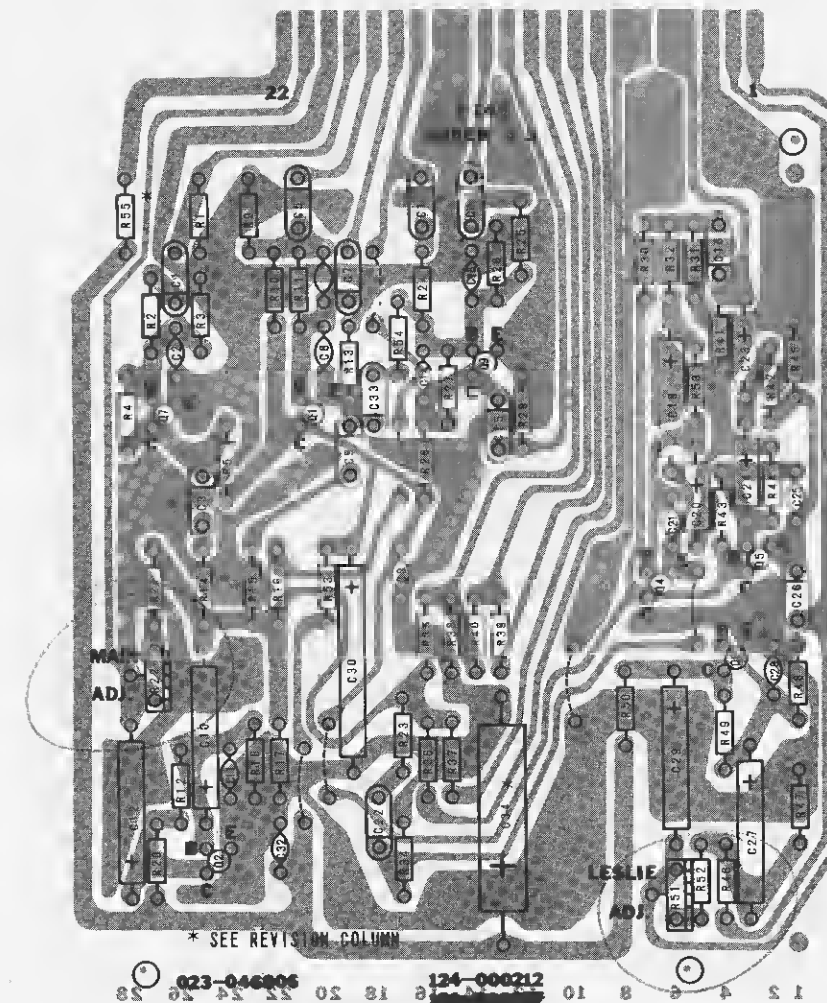
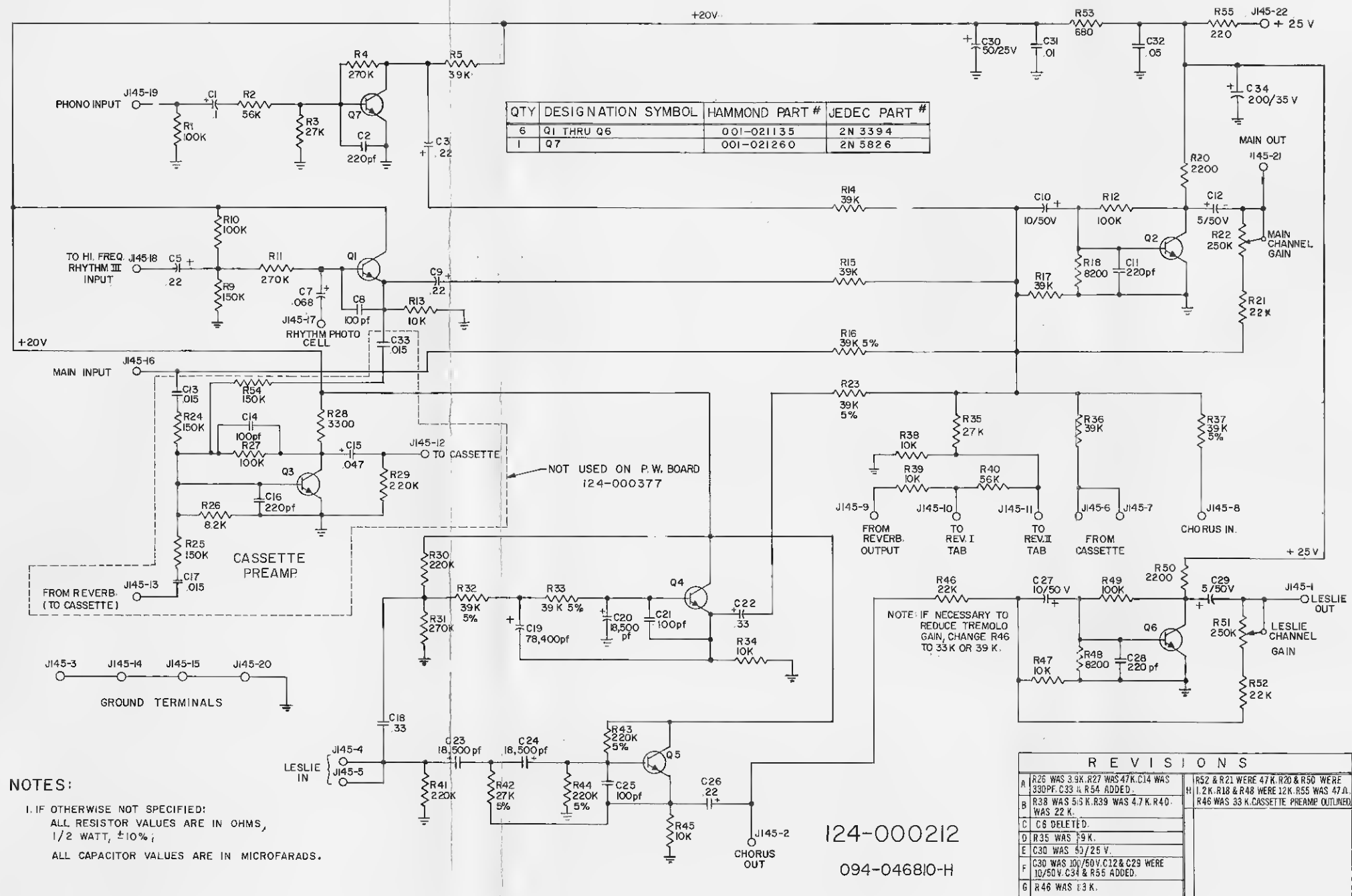
HOW PHASE SHIFT OCCURS: Assuming the two extremes of FET resistance to be zero ohms and infinity, at the zero point the collector signal is attenuated by the reactance of capacitor C3, so the signal appearing at the junction of C3 and the FET has the phase of the emitter signal. When the FET goes to open circuit or infinite resistance, the C3-FET junction is connected only to the collector signal, phase 180° away from the emitter signal. Since reactance is a function of frequency, a frequency occurs where capacitor C3 reactance equals FET resistance. At this point, the phase appearing at the C3-FET junction is 90° away from both collector and emitter. As the FET resistance varies smoothly between its limits, the phase of signals appearing at the junction varies smoothly between the limits determined by capacitor reactance and signal frequency. Since an instantaneous change in phase is equivalent to a change in frequency, a vibrato effect is obtained when phase is changed at vibrato rate in a sine-wave manner. A single stage does not provide sufficient phase shift for the required vibrato effect, so four stages have been cascaded. The fourth stage is amplified to provide standard level (1V) and impedance. The single transistor joining the base of the final output transistor to ground is a delay switch to hold output cut-off until circuit voltages have stabilized after power is applied.



* NOT USED ON THIS ASSEMBLY

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FIGURE 3-26
 AFTER VIBRATO BOARD
 SCHEMATIC, LAYOUT AND THEORY
 (124-000213)



MIXER #3 BOARD (124-000212)

This assembly provides cassette mixing, phono preamplification, acoustic tremolo crossover filtering, expression pedal contouring. (for rhythm white noise voices.) a chorus input, and final mixing before main and tremolo power amplifiers. Single stage mixer preamps, (Q3 and Q7) are used for phono and cassette inputs at J-145-19 and 13. Q1 supplies contouring for Rhythm III white noise voices. (input at J-145-18) Q4 and Q5 are low and high pass filters for the tremolo channel whose input is at J-145-4. Because final tremolo signals are acoustic and cannot be recorded directly, animation of recorded signals is accomplished

by routing tremolo channel through the reverb after vibrato (124-000213) via J-145-5, then back to mixer #3 via J-145-13 where it is coupled by R25, R26 and C16 to the base of amplifier Q3 and proceeds to cassette input from J-145-12. If desired, reverb must be added to recorder playback signal. R22 controls output gain of summing amplifier Q2, final mixer for the main channel, at J-145-21. The tremolo channel output is at J-145-1, and the gain of the summing amp for this channel (Q6) is regulated by R51. C34 and R55 make up a +25 V decoupling filter which reduces turn on thump. Input impedance of

the phono preamp is 50 K ohms and an input of 250 mv drives the main power amp to an output of 35 watts R. M. S.

NOTE: Decoupling filter R55-C34 is not used on earlier versions of this assembly.

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FIGURE 3-27
MIXER BOARD #3
SCHEMATIC LAYOUT AND THEORY
(124-000212)

124-047850 ARPEGGIATOR BOARD

An electronic system for producing an Arpeggio, Glissando, or whole tone scale as desired, by stroking a miniature keyboard under a mylar strip located between the manuals. Next to the strip is a switch that selects between MANUAL and AUTOMATIC modes. In the MANUAL mode, ground is disconnected from Q1 and Q2, through R2 and R3. The keys depressed on the lower manual determine which notes registered on the upper manual will be heard, including those in octave relation thereto. If no lower manual keys are activated, the Arpeggiator strip is dead. Twelve circuits are used, one for each note of the scale. Diodes D24 thru D32 activate the "C" buss whenever a "C" note is keyed on the lower manual while providing isolation between the lower manual keyers, similarly, the "C#", "D", "D#", etc., busses will activate when these notes are played. Keying a buss will apply voltage on all octaves of that note on the Arpeggiator switches. Now if the Apreggiator is stroked, all octaves of the notes held on the lower manual will sound in succession as if they had been played on the upper manual, due to the connection of the Arpeggiator switches to the upper manual keyers.

OPERATING IN AUTOMATIC MODE:

Q1 and Q2 are normally turned on by grounding their bases through R2 and R3, supplying -18V to all keying busses from the emitters through the collectors and diodes D1 through D6 and D15 through D20. (When no keys are depressed on the lower manual). This activates all busses at slightly less than full keying voltage. When the Arpeggiator strip is stroked, all notes play in succession (GLISSANDO). If notes in the SAME whole tone scale are depressed, -28V will be applied to the base of the associated transistor, turning it off and removing the -18V from the busses for the other whole tone scale. Only the proper whole tone scale, in tune with notes depressed, will play. If a chord is keyed on the lower manual that has notes in BOTH whole tone scales, busses are activated with -28V on left and right sides, reverse biasing both transistors so only the busses for the notes depressed on the lower manual are activated. Consequently, only corresponding notes on the Arpeggiator become playable. Therefore, when the miniature keyboard is stroked, a Glissando occurs if no lower manual keys are depressed, and an Arpeggio is heard if one or more keys are held, but always in harmony with those keys.

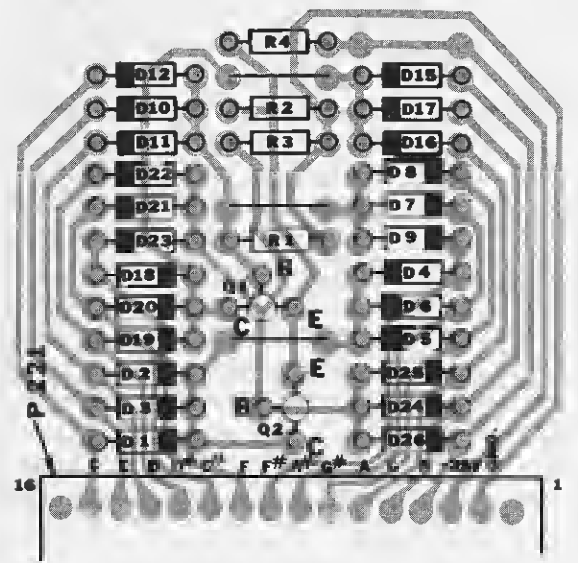
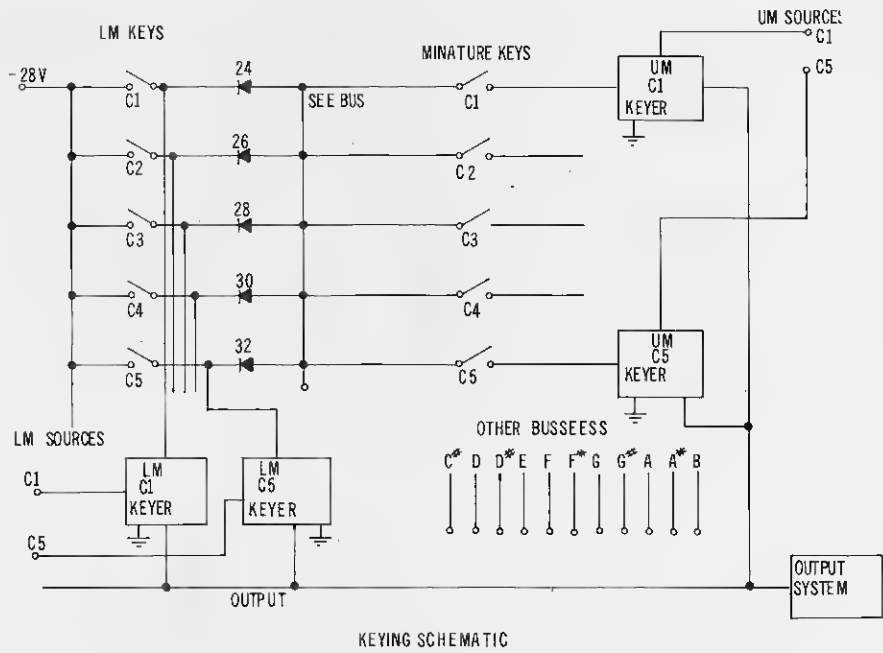
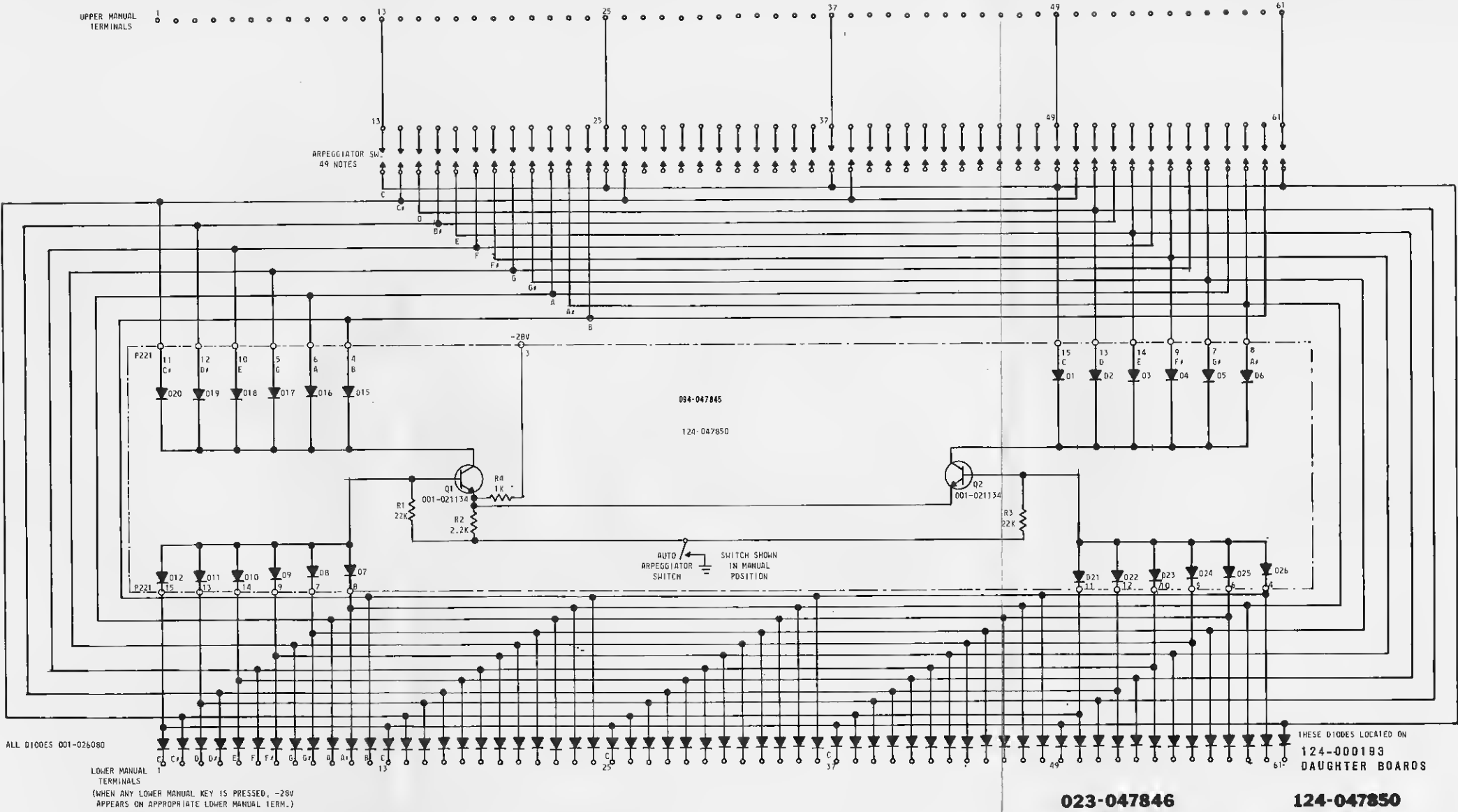
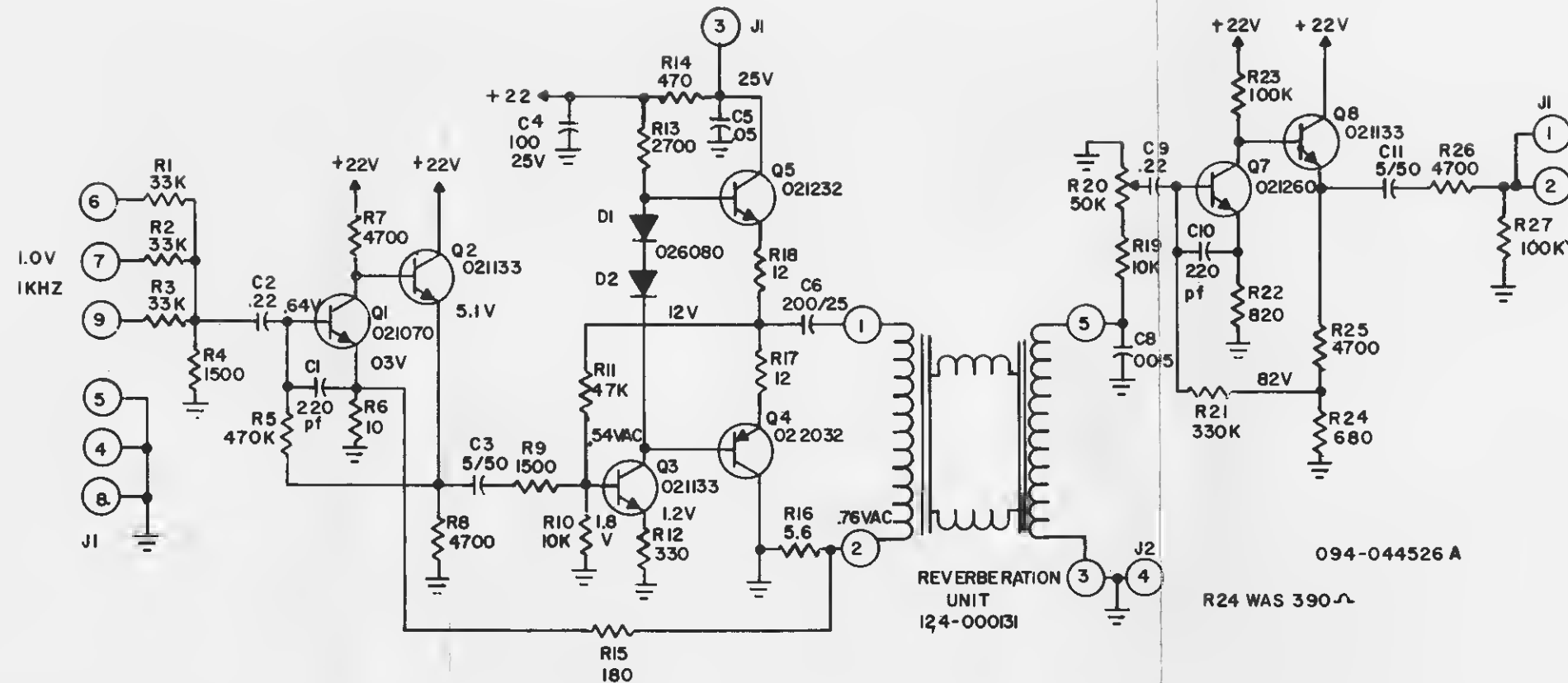


FIGURE 3-28
ARPEGGIATOR BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-047850)



REVERBERATION BOARD 124-000166

Signal is fed through R1, R2, or R3 and coupled through C2 to the base of Q1. Bias for Q1 is supplied through R5. From the collector of Q1, the signal is coupled directly to the base of emitter follower Q2. Bias for Q2 is provided through R7. The signal from the emitter of Q2 is developed across R8 and coupled by C3 and R9 to the base of Q3. Bias for Q3 is supplied through R11. From Q3 collector the signal is coupled in half-wave position to the push-pull amplifier comprised of Q4 and Q5. The negative portion of the signal is coupled directly to the base of Q4, a PNP. Forward bias on D1 and D2 prevents the negative portion of the signal from reaching Q5. The positive portion of the signal is of sufficient amplitude to reverse bias D1 and D2, and this portion of the signal is then passed to the base of Q5, an NPN. The outputs of the two transistors are combined at the junction of R17 and R18, and coupled through C6 and J2-1, to drive

the reverberation unit whose input is connected to this point. Negative degenerative feedback is taken from R16, and connected through R15 to the emitter of Q1.

REVERBERATION RECOVERY

Through a reverberation unit there is considerable loss of signal strength. Therefore, the output of the unit must be amplified to restore the signal to sufficient amplitude to drive a power amplifier.

The signal from the reverberation unit at J2-5 is coupled through R19, R20, and C9 to the base of Q7. Bias and feedback for Q7 are supplied through R21. The output at Q7 collector is coupled directly to the base of Q8. The signal of the reverberation recovery at the emitter of Q8 is coupled to J1-1 through C11 and R26. Resistor R26 is part of a Reverb. Volume control.

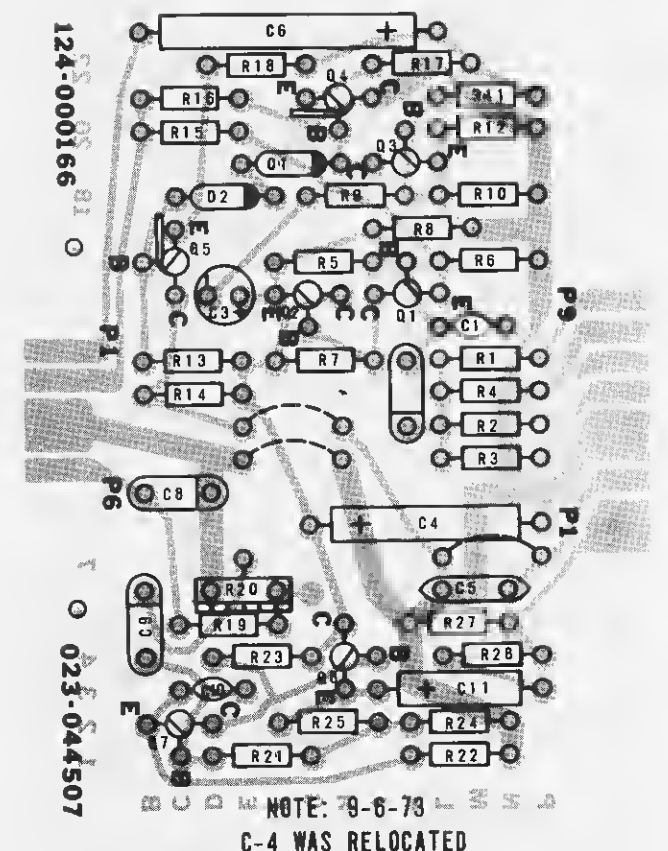
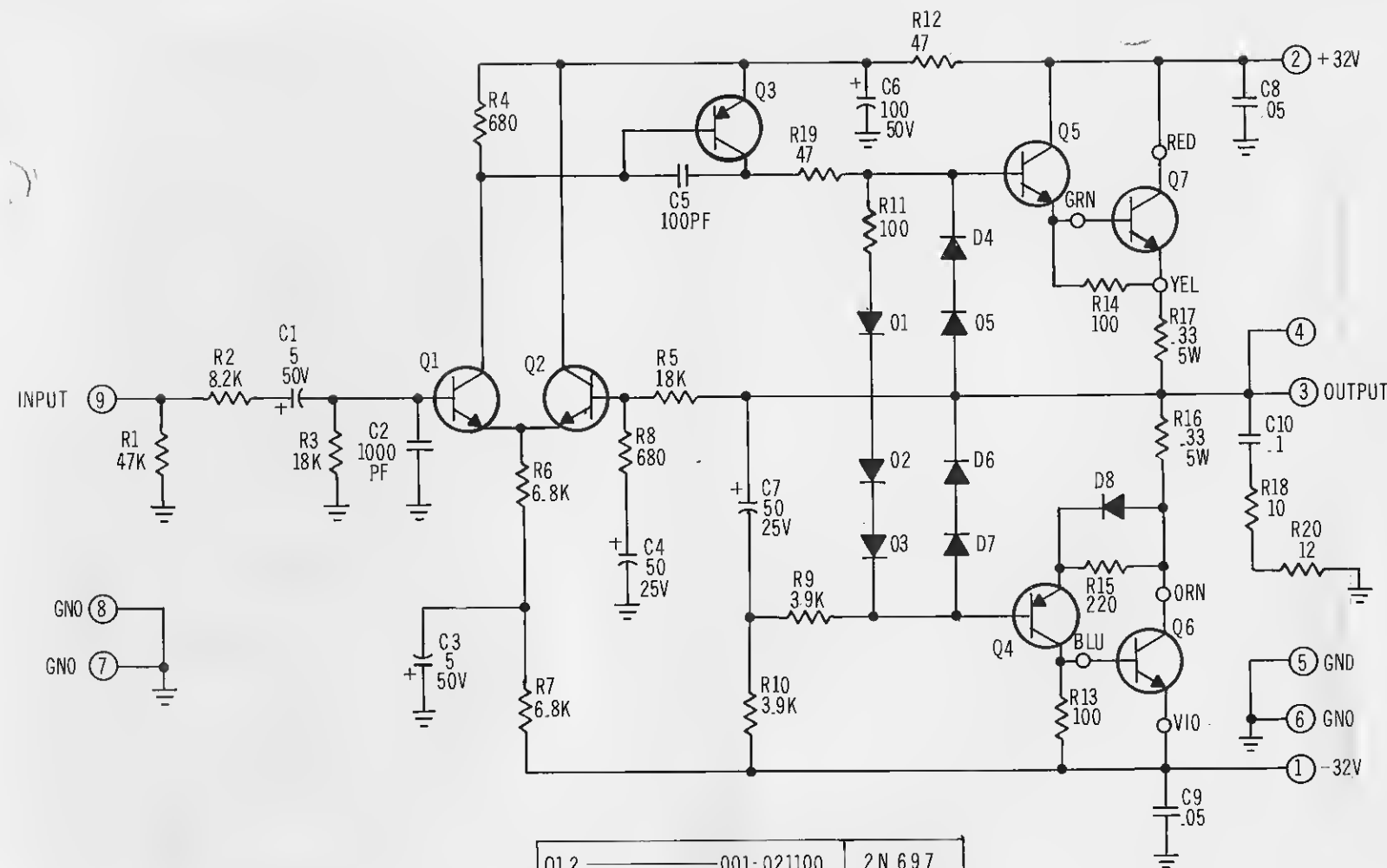


FIGURE 3-29
REVERBERATION BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-047850)

24



124-000169
094-044907-B

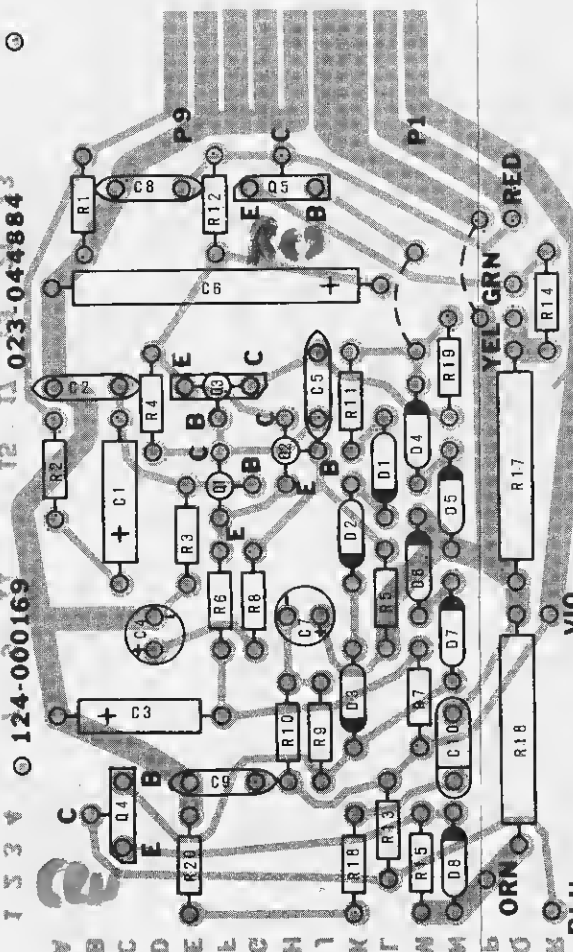
35 WATT POWER AMP MODULE

A differential amplifier used for the input circuit keeps the output at D.C. ground by compensating the bias of the output transistors. This circuit makes quasi-complementary output practical by eliminating the bias problems. Transistors Q1 and Q2 are biased equally to ground with R3 and R5. Since the load is connected to the base of Q2 through R5, ground potential is achieved at the load.

The D.C. feedback path from the load to the base of Q2 also presents a convenient way to apply A.C. feedback. The amount of feedback is controlled by R8 and R5 and their ratio determines the overall gain of the amplifier. The high open loop gain, which permits the large negative feedback, is due to transistor Q3 which operates class A with its emitter at A.C. ground. This means that Q3 must withstand the total voltage across the amplifier.

Three diodes, D1, D2, and D3, represent part of the load seen by Q3 and perform the important function of biasing the output transistors. In order for Q6 and Q7 to be biased on, the voltage drops across D1, D2, and D3 must equal the voltage drops across the emitters Q4, Q5, and Q7 plus the drops across D8, R16, and R17. The current through the three series diodes is determined by R9, and R10, and this current, in turn, determines the voltage drop across the diodes. A Q6, Q7 quiescent current of approximately 40 Ma is necessary to prevent crossover distortion.

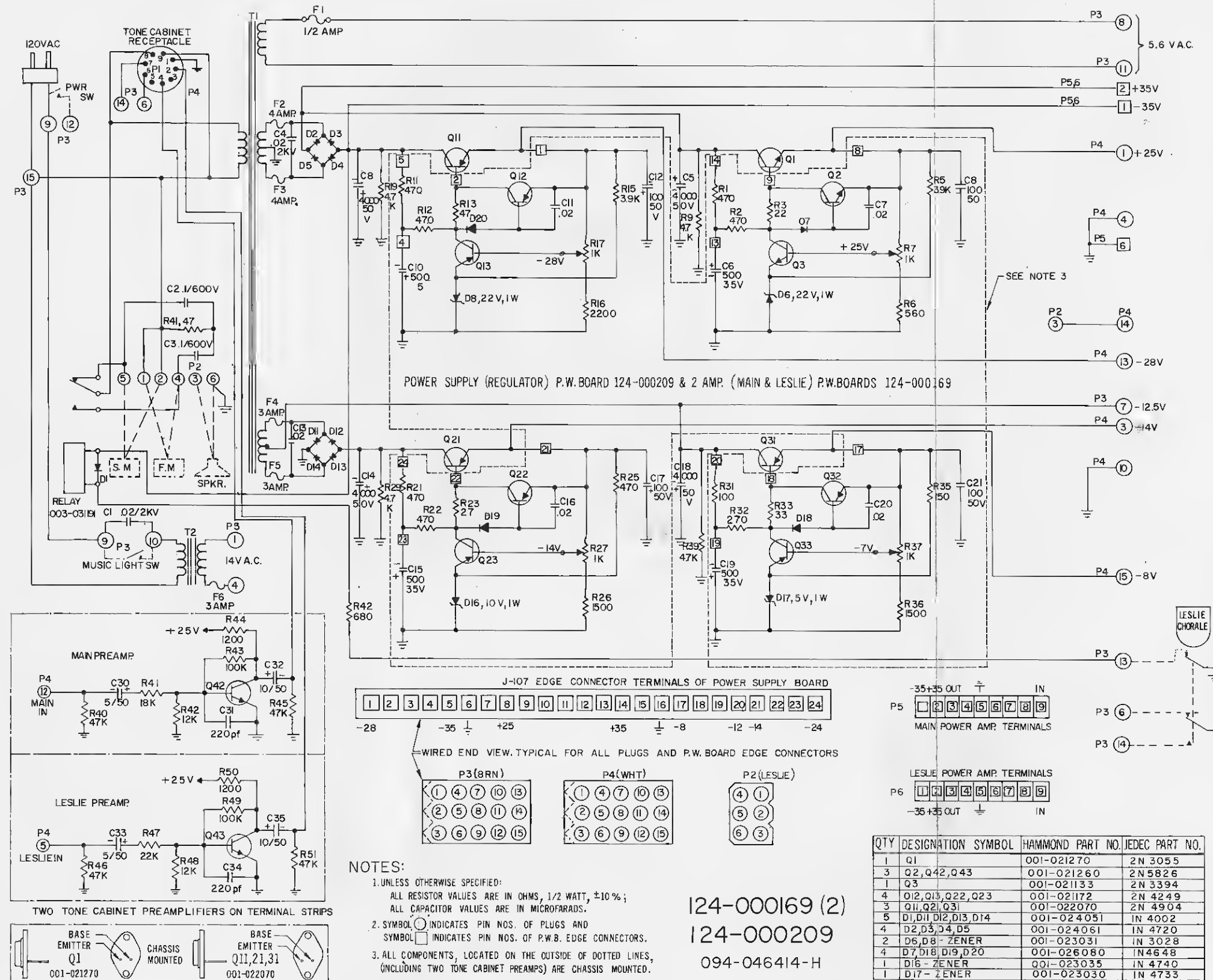
Transistors Q5 and Q7 are NPN Darlington connected, while Q4 and Q6 act like a PNP Darlington connection. Resistor R15 and D8 causes the overall transconductance of Q4 and Q6 to be nearly the same as that of Q5 and Q7 thereby improving the linearity of the output stage. A bootstrap capacitor C7 is connected be-



between R9 and R10 enabling Q6 to be driven into saturation. Without the positive feedback path through C7, there is insufficient drive to Q6 for symmetrical output.

RC pad R18, and C10 across the load provides high frequency stabilization. Short-circuit protection is accomplished during the positive cycle by series-connected diodes D1 to D6, in parallel with Q4 and Q5 emitters and R17. The diodes shunt the drive to Q7 and clamp its collector current at a level just above the normal peak load current. The collector current of Q6 is clamped during the negative cycle in the same manner as that of Q7 with diodes D5 and D3.

FIGURE 3-30
35 WATT AMP BOARD
SCHEMATIC, LAYOUT AND THEORY
(124-000169)



NOTES:

1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 10\%$;
ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. SYMBOL INDICATES PIN NOS. OF PLUGS AND
SYMBOL INDICATES PIN NOS. OF P.W.B. EDGE CONNECTORS.
3. ALL COMPONENTS, LOCATED ON THE OUTSIDE OF DOTTED LINES,
(INCLUDING TWO TONE CABINET PREAMPS) ARE CHASSIS MOUNTED.

124-000169 (2)
124-000209
094-046414-H

124-000209 POWER SUPPLY REGULATOR BOARD

For the regulation and short-circuit protection of four (4) power supply circuits, (+25V, -14V, -28V and -8V) Zeners D6, D8, D16 and D17 supply reference voltage, potentiometers R7, R17, R27 and R37 are voltage adjustment controls for setting the base voltage of power transistors Q1, Q11, Q21, and Q31, thus setting output (emitter) voltage. When the output load increases, the base voltage drops on regulating transistors, Q3, Q13, Q23, and Q33,

allowing their collector voltage to become more negative as well as the base of the power transistors, bringing them closer to saturation and restoring output (emitter) voltage. If a short or similar condition is present, emitters of protection transistors Q2, Q22, and Q32 are grounded or brought near ground which in turn grounds the base terminals of the power transistors, turning off supply. Base resistors and diodes set the point at which protection transistors turn off.

P3 TERMINALS:

- 18,4 LIGHT TRANSFORMER, 14VAC
- 2 MAIN CHANNEL OUTPUT
- 5 LESLIE CHANNEL OUTPUT
- 3 MAIN SPEAKER GND
- 8,11 EXPRESSION PEDAL 5.6VAC
- 9,10 POWER SWITCH
- 6,4 TONE CABINET CHORALE
- 13 LESLIE CHORALE
- 7 -12.5V CASSETTE SUPPLY

P4 TERMINALS:

- 1 +25V D.C
- 3 -14V D.C
- 13 -28V D.C
- 15 -8V D.C
- 4 GNDS(+25,-28V)
- 10 GNDS(-14,-7V)
- 7 PHONO INPUT
- 8 GND (PHONO)
- 2 LESLIE CHANNEL INPUT
- 9 MAIN CHANNEL INPUT
- 6 GND (INPUTS)
- 12 TONE CAB INPUT (MAIN)
- 5 TONE CAB INPUT (LESLIE)
- 14 LESLIE SPEAKER

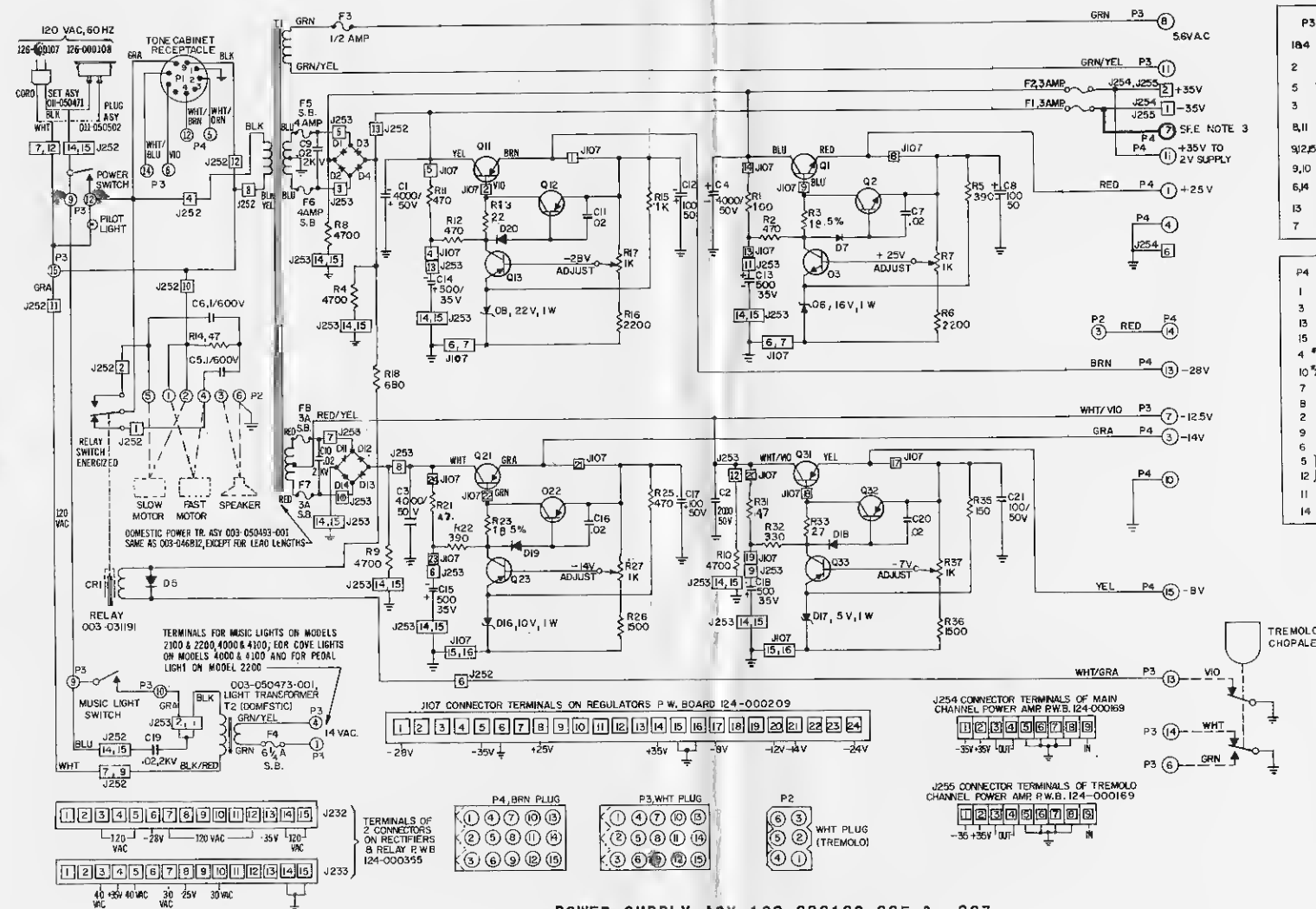
REVISIONS

- IN P4 TERMINAL FUNCTIONS, TERM. 12 WAS TONE CABINET (LESLIE), TERM. 14 WAS GND OF LESLIE SPEAKER & TERM. 11 LESLIE SPEAKER, DELETED, 02 WAS 001-021160.
- R2 WAS 1200, R31 & R32 WERE 470, R34 WAS 330.
- IN P4 TERM. FUNCTION, TERM. 5 WAS LESLIE & TERM. 12 WAS MAIN, ADDED MAIN & LESLIE PREAMPS W/ CONNECTIONS TO P1, Q1, Q21 & Q31 WERE 001-02050, Q1 WAS 001-021180, R6 WAS 4700, R12 & R22 WERE 1200, R23 WAS 56.
- TERM. P4-5 WAS P4-12 & P4-12 WAS P4-5, Q42 & Q43 WERE 011-021135.
- C6, C10, C15 & C19 WERE 25 V, LESLIE & CHORALE REPLACED WITH TREMOLO & CELESTE.
- R23 WAS 33.
- R32 WAS 390.
- R32 WAS 330.

* SEE REVISION COLUMN

26

ON/OFF
WHITE PLUG P-3
PN 9, 12



POWER SUPPLY ASY 126-000108-005 & -007
094-050625-E

NOTES:

1. UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/2 WATT, $\pm 10\%$;
ALL CAPACITOR VALUES ARE IN MICROFARADS;
ALL SWITCHES ARE IN "OFF" POSITION.
2. SYMBOL INDICATES:
② P3 PIN 2 IN PLUG P3;
③ J107 PIN 3 IN R.W. BOARD EDGE CONNECTOR J107;
④ J107 TWO (OR MORE) INTERCONNECTED PINS 14 AND 15
J232 ON P.W. BOARD EDGE CONNECTOR J252
3. ON 126-000108-005 & 007
P4-7 IS -35V AND P4-8 IS OPEN.

QTY	DESIGNATION	SYMBOL	HAMMOND PART NO.	JEDEC PART NO.
1	Q1		001-021270	2N 3053
1	Q2		001-021260	2N 5826
1	Q3		001-021133	2N 3394
3	Q11, Q21, Q31		001-022070	2N 4904
6	Q2, Q3, Q22, Q23, Q32, Q33		001-021172	2N 4249
8	D1 THRU D4 & D11 THRU D14		001-024061	1N 4720
1	D5		001-024051	1N 4002
1	D6, ZENER, 16 V, 1W		001-023036	1N 4745
4	D7, D18, D19, D20		001-026080	1N 4148
1	D8, ZENER, 22 V, 1W		001-023031	1N 3028
1	D16, ZENER, 10 V, 1W		001-023035	1N 4740
1	D17, ZENER, 5 V, 1W		001-023030	1N 4733

REVISIONS

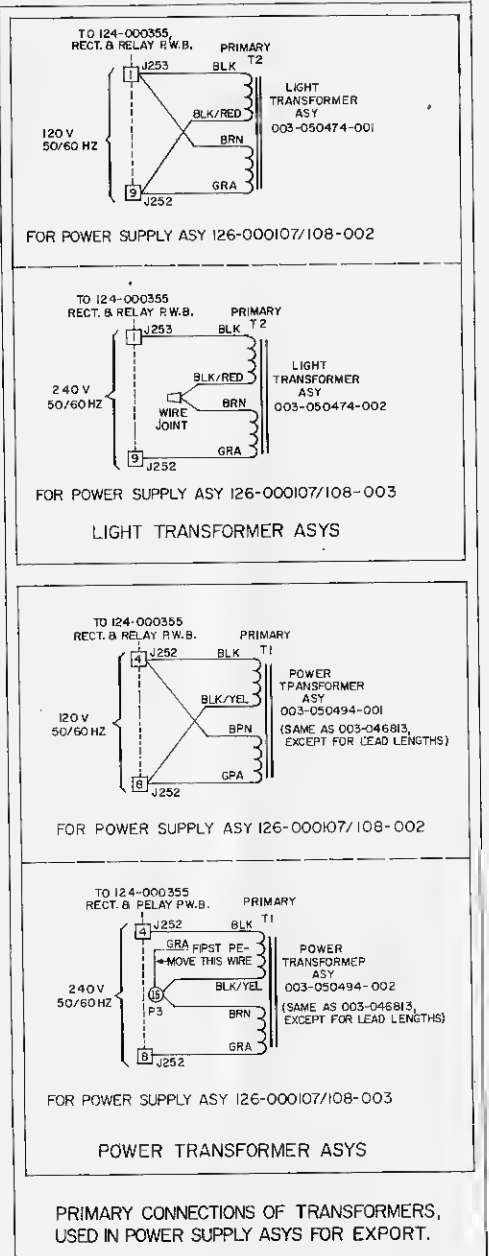


FIGURE 3-31A
POWER SUPPLY ASSEMBLY
SCHEMATIC AND LAYOUT
(124-000209)

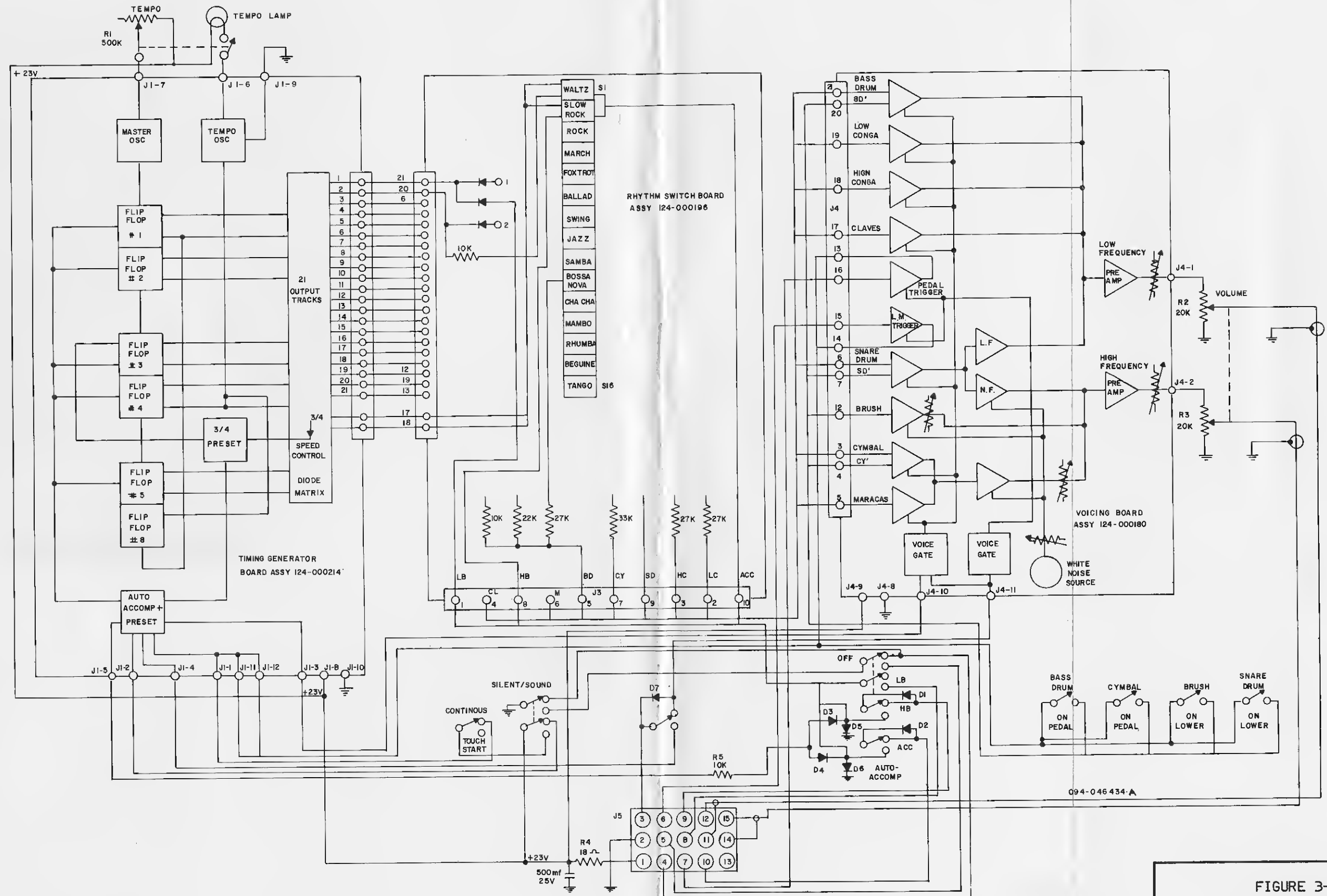
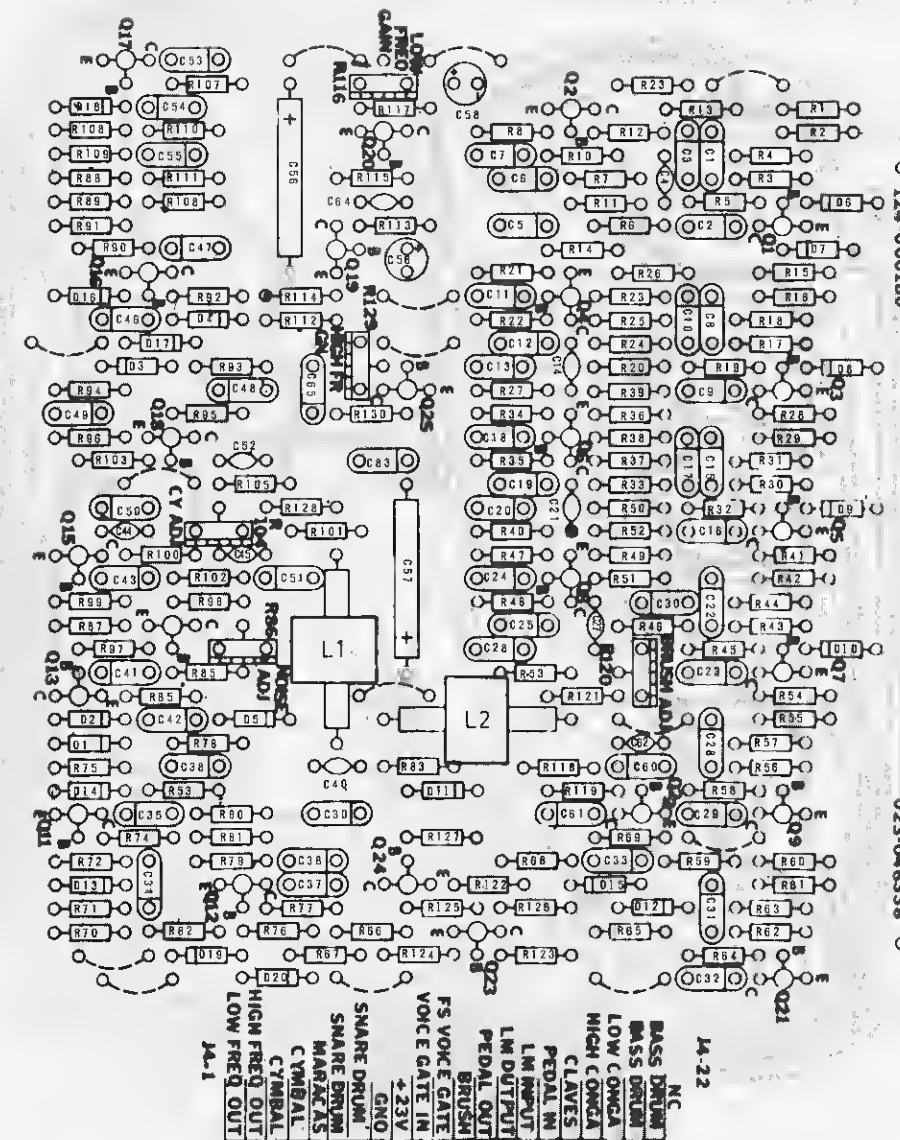
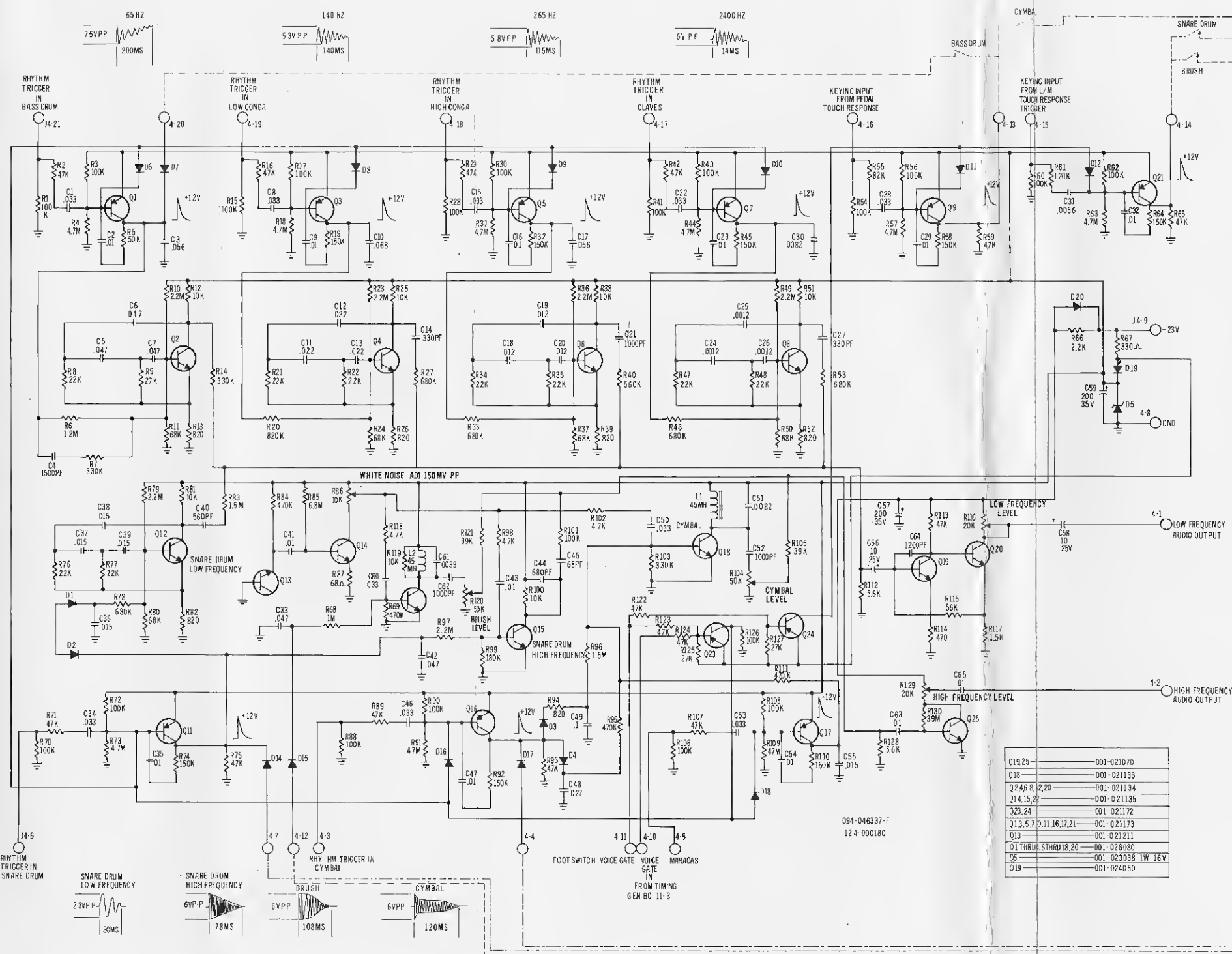


FIGURE 3-32
RHYTHM III LOGIC
DIAGRAM
(125-000082-001)



VOICING BOARD
124-000180

The voicing board produces the frequencies for the different rhythm voices. High frequency audio output has Brush, Cymbal, and the high frequency part of the Snare Drum voice. The low frequency audio output has Bass Drum, Low Conga, High Conga, Claves, and the low frequency part of the Snare Drum voice.

The inverter stages for the phase shift oscillator consist of transistors Q1, Q3, Q5, Q7 and Q11. These stages receive a negative pulse to be fed on the base of the oscillator transistors Q1, Q2, Q6, Q8, and Q12. The duration of oscillation is determined by the RC network formed by the capacitors C3, C10, C17, C30 and the series resistance to the base of the transistor in the oscillator.

The output of the oscillator is fed to the low frequency pre-amplifier consisting of Q12 and Q20.

The voice gate stages hold the inverter transistors biased off by allowing a positive voltage on the bases of these transistors. When a positive gate is applied to the base of gate transistors Q23 and Q24, the transistors are biased off, which allows the inverter transistors to be forward biased.

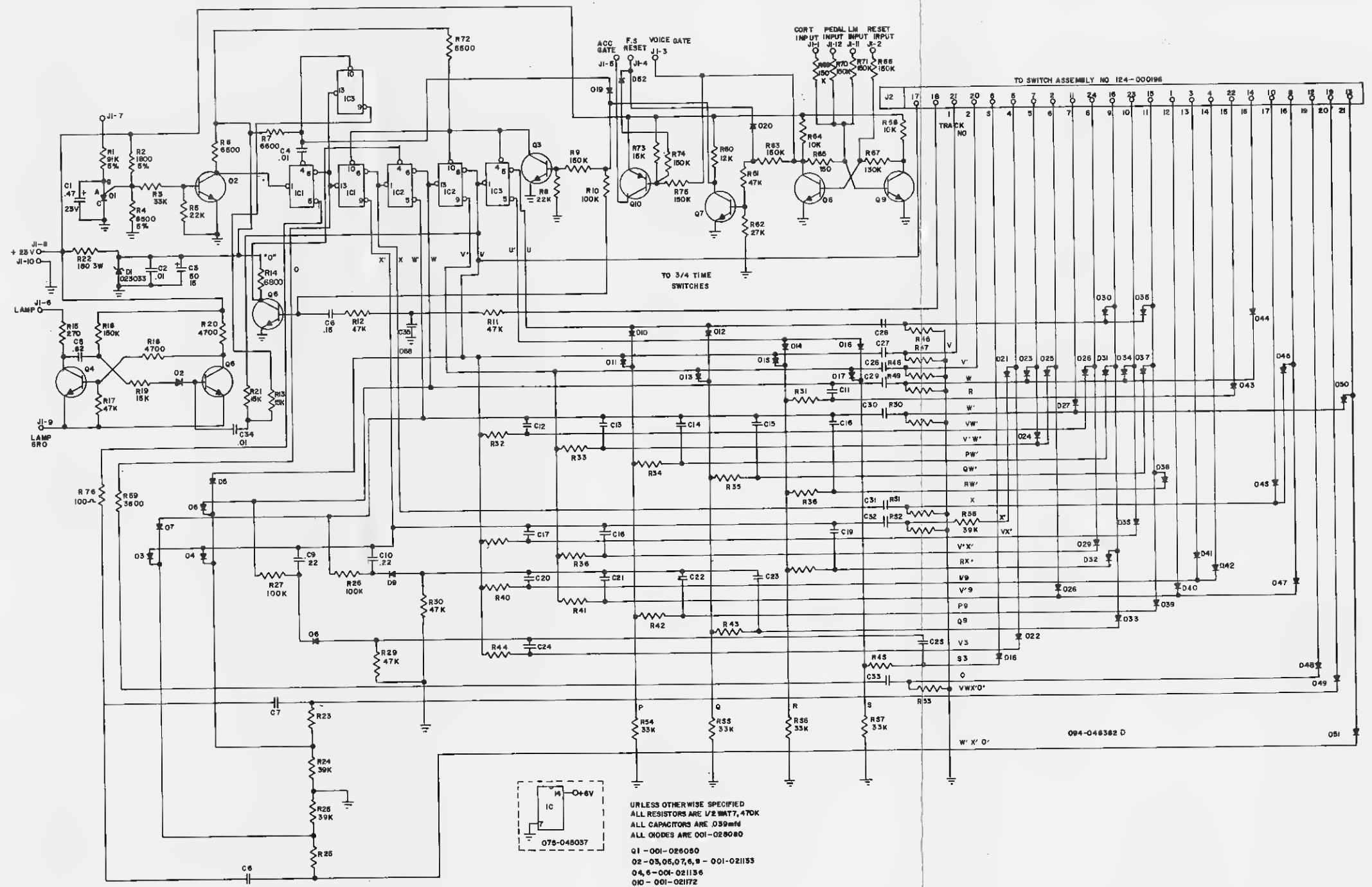
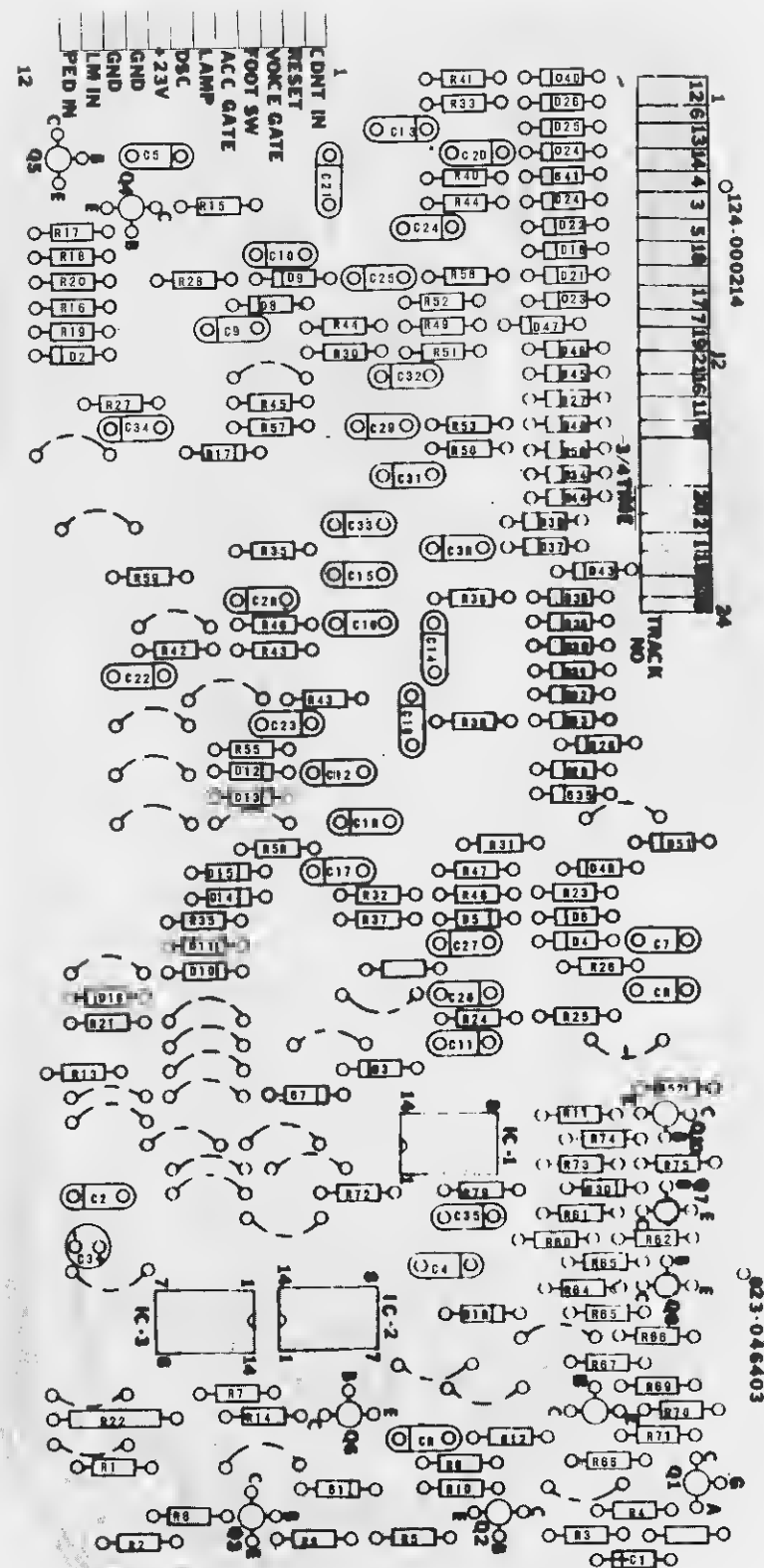
The white noise for high frequency sound is generated by the reversed biased transistor Q13 with the collector open. The white noise signal is amplified and fed through the potentiometer R86 to the cymbal amplifier, Q18. The tank circuit in the collector has a resonant frequency approximately the sound of a cymbal. The transistor is forward biased by an inverter circuit, similar to the prior ones mentioned.

The Brush amplifier Q22 amplifies the white noise signal and this signal together with the cymbal signal is fed to the high frequency amplifier.

The Snare Drum circuit has an inverter stage and a phase shift oscillator. A variation from the other voices is the inverted input pulse is fed to two points; phase shift oscillator, and to the frequency muting circuit, consisting of transistor Q15 plus the RC network.

FIGURE 3-33
RHYTHM VOICING BOARD
SCHEMATIC, AND LAYOUT
(124-000180)

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124-000214 RHYTHM III ASSEMBLY
TIMING GENERATOR BOARD

To regulate rhythm patterns and tempo, timing rates are geared to a relaxation oscillator controlled by a programmable uni-junction transistor (PUT). The rate is controlled by varying the charging current for C1 through the control panel pot. Oscillator output drives a buffer transistor which, in turn, drives a five stage counter made up of 3 dual J-K, DTL flip-flops. Half of IC-3 provides pulses at a beat rate to the lamp (one shot only) when stages 2 through 5 of the counter are reset by Q3 and Q6. The five stage counter normally accepts 32 pulses before restarting. When Waltz or Slow Rock rhythm patterns are called for, the output of the fourth divider is fed back to the third divider through Q6. This feedback pulse will cause the counter to restart after reaching 24. The output of the fourth divider is also used to trigger a one-shot through R21 and C34 driving the tempo lamp at a measure rate.

A set, re-set bistable made up of Q8 and Q9 with resistors R64 through R71, is used for the Touch-Start circuit. Q8 provides voice gating signals for the voicing board (124-000180) and for generator gates controlled by Q7 and Q10. A positive pulse applied to the re-set input (J1-2) causes Q8 to provide a ground signal that turns off voice gating circuits, (J1-3) and is inverted by Q7. A positive signal is supplied by Q7 to Q3 and Q6, who, in turn, re-set stage 2 through 6 of the counter and the beat rate divider. (Pin 9 of IC-3). A positive pulse applied to any of the three "start" inputs, (J1-1, J1-11, J1-12) causes the bistable to change state, allowing the voice gates to open, removes the re-set signal from stages 2 through 6 of the counter, turns off the beat rate divider, and provides a re-set pulse to counter stage 1 through C4. The counter outputs are decoded and differentiated by a diode/capacitor matrix to form specific pulse sequences, the matrix has 21 output tracks which are fed to the Rhythm Selector Board. (124-000196).

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FIGURE 3-34
RHYTHM GENERATOR BOARD
SCHEMATIC, AND LAYOUT
(124-000214)

RHYTHM III. Theory of Operation

MASTER OSCILLATOR: The master oscillator is a relaxation oscillator controlled by a programmable unijunction transistor (PUT). The rate is controlled by varying the charging current for CI through the control panel mounted potentiometer. The output of the oscillator drives a buffer transistor, which in turn drives the first stage of a five-stage counter.

COUNTER: The five-stage counter is made up of 3 dual J-K, DTL flip-flops. One-half of IC 3 is used to provide pulses (at a beat rate) to the lamp one-shot only when stages 2 through 5 of the counter are reset by O3 and O6. The five-stage counter normally counts to 32 before restarting. When either the Waltz or the Slow Rock rhythm patterns are called for, the output of the fourth divider is fed back to the third divider through Q6. This feedback pulse will cause the counter to restart after a counter of 24. The output of the fourth divider is also used to trigger a one-shot through R21 and C34 which drives the tempo lamp at a measure rate.

TOUCH START CONTROL: The Touch Start circuit is a set-reset bi-stable comprised of transistors Q8 and Q9 and resistors R64 through R71. The output of transistor Q8 provides signals for voice gates on the Voicing Board (124-000180) and also for generator gating circuits controlled by transistors Q7 and Q10.

When a positive input pulse is applied to J1-2 (reset input), transistor Q8 provides a ground signal that turns off the voice gating circuits (J1-3), and is inverted by transistor Q7. Transistor Q7 provides a positive signal to transistors Q3 and Q6 which reset counter stage 2 through 6 and enable the beat rate divider (Pin 9 of IC3). When a positive pulse is applied to any one of the three "start" inputs (J1-1, J1-11, J1-12), the set-reset bistable changes state, which enables the voice gates to open, removes the reset signals from the counter stages 2 through 5, turns off the beat rate divider, and provides a reset pulse to the first stage of the counter through capacitor C4.

DIODE MATRIX: The outputs from the counter are decoded and differentiated by a diode/capacitor matrix to form specific pulse sequences. The diode matrix has 21 output tracks which are fed to the Rhythm Selector Board.

RHYTHM VOICES: There are eight rhythm voices used in this rhythm unit. They are Bass Drum, Low Conga, High Conga, Claves, Snare Drum, Brush, Cymbal, and Maracas. The Brush, Cymbal, Maracas, and the high frequency part of the Snare Drum are generated by shaping and formanting the output of a white noise source. The white noise is generated by a reverse biased transistor. The outputs of the white noise voices are combined and fed to a high frequency pre-amplifier whose output appears on J4.

pin 2.

The remaining voices are generated by R-C oscillators which are turned on by a pulse amplifiers that provide the bias current for the oscillators. The outputs of all of the R-C oscillators are mixed together and then fed into a low frequency pre-amplifier whose output appears on J4 pin 1. The outputs of both pre-amplifiers are connected to a dual volume control, and the outputs of the volume control go to the output connector.

PLAY-A-LONG VOICES: There are two pulse inverter circuits, which invert input signals from the lower manual legato trigger circuit and also from the pedal touch mode trigger circuit. The output of the lower manual inverter (J4-14) can be switched to either the Brush input (J4-14) or the Snare Drum input (J4-7) by front panel tabs. The output of the pedal inverter (J4-13) can be switched to either the Bass Drum input (J4-20) or the Cymbal input (J4-4) by front panel tabs.

PATTERNS NAMES	RHYTHM VOICES ASSIGNED	TRACK NUMBERS (1-21)	BEAT / TWO MEASURES																AUTOCHORD TRACK NOS.		
			1				2				3				4				LO	HI	ACC
	TEMPO LAMP																		BASS		
WALTZ	CY SD BD	15 2 + 7 (1)*																	1	-	2+7
SLOW ROCK	CY CY SD BD	19(33K) 20 13 (1)*																	1	13	19
SHADED AREAS ARE TIME INTERVALS SKIPPED																					
ROCK	CY SD BD	19 7+13 14+16																	1	2	19
BOSSA NOVA	CY CL SD BD BD	19 3+11 7 (1)*+14 16(27K)																	1	2	11+14
SAMBA	M CL SD HC LC BD	19 16 8+11 9 2 (1)*																	1	2	8+11
MAMBO	M CY SD HC LC BD	19 7 3+10 15 12 (1)*																	1	2	3+10
RHUMBA	M CL HC LC BD	19+20 11+15 6 8 (1)*																	1	2	8
BEGUINE	M CY CL HC LC BD	19 4 11+3 4(27K) 5(27K) (1)*																	1	2	3+11
CHA CHA	M CY SD LC BD	19 8 7 3+5 (1)*																	1	2	8
FOX TROT	M CY SD BD	17+20 7 7 (1)+2(10K)																	1	2	7
SWING	CY SD BD BD	16+21 7 17(22K) (1)*																	1	2	7
MARCH	CY SD BD	17 5+9 (1)*+16																	1	2	17
BALLAD	CY SD BD	19 + 20 7 12+2(22K)																	1	2	7
JAZZ	M CY SD BD	6 12+13 7 (1)*+17(22K)																	1	2	7
TANGO	CY SD CL HC LC BD	12 18 11 13 3 (1)*+17(10K)																	1	2	18

HC — HIGH CONGA
LC — LOW CONGA
RS — RIM SHOT
C — CLAVES
SD — SNARE DRUM
M — MARACAS
CY — CYMBAL
BD — BASS DRUM

Small Dots indicate attenuated loudness.
Bass Drum always connected to track 1 through 10K

FIGURE 3-35
RHYTHM III PATTERNS
CHART AND THEORY